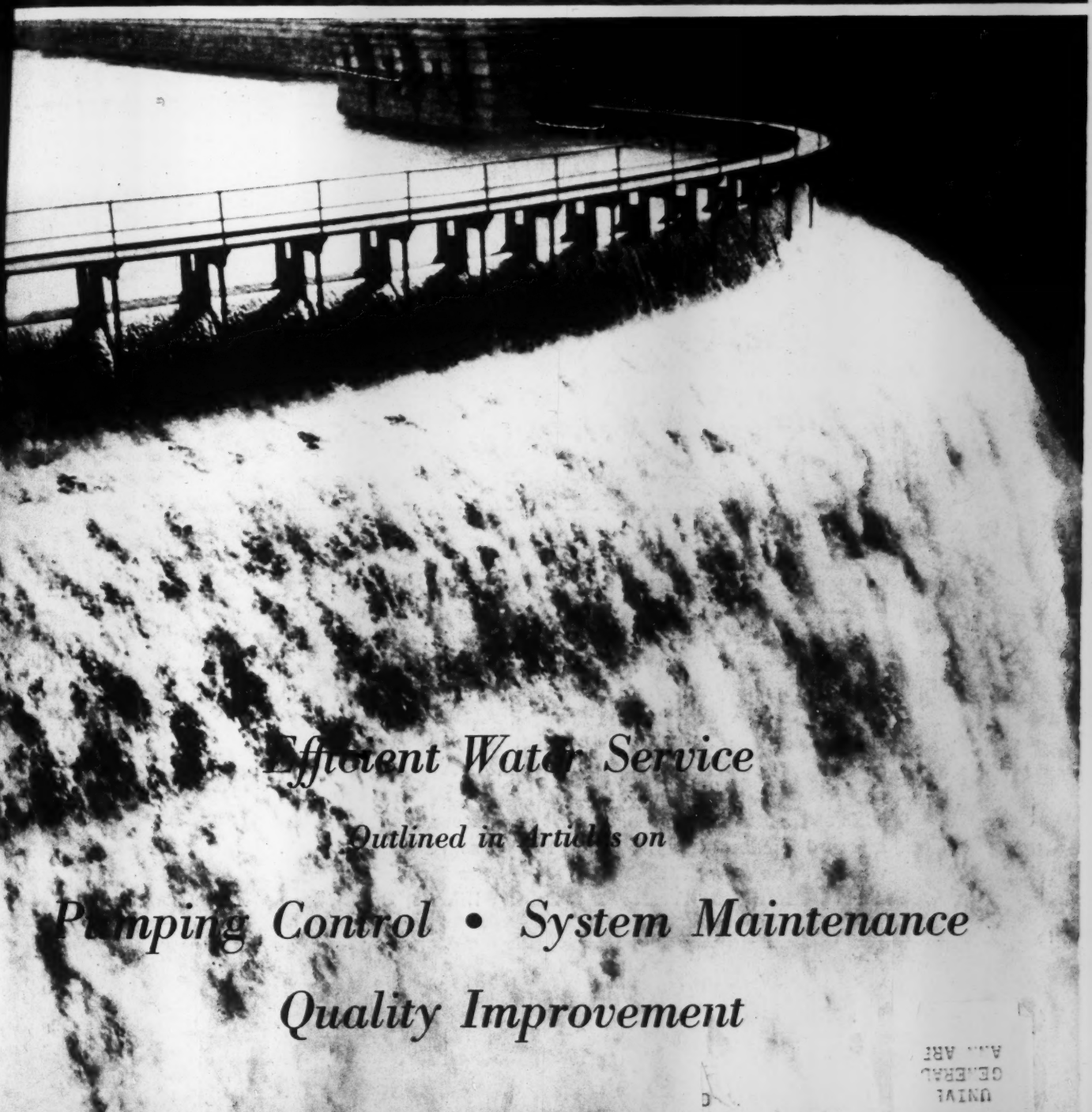
Engineering News-Record

May 28, 1936



Efficient Water Service

Outlined in Articles on

Pumping Control • System Maintenance

Quality Improvement

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When JOHN PUBLIC *Turns the Tap*

MAN is prone to take for granted his most precious gifts. His scant respect for the air he must breathe he reflects in the phrase, "free as air." Rarely does he ponder by what miracle of coordination the city-dweller is enabled to choose daily from an infinite variety of foods mysteriously spread before him.

And water? Who cares what mighty rod has smitten what rock so long as he can reach for a convenient tap and draw his fill? The average man is more likely to be concerned over his supply of Scotch than over the water he may use to dilute it. The water he takes for granted—until the pipes run dry or until an excess floods him out.

In these days, it appears, the flood pesters him more than does the famine; the water usually is at the tap when he reaches for it. In all that, he sees no miracle; the miracle would be to find it dry. He just takes it for granted, like all the other precious things of life.

But an ample supply of pure water does not "just happen." If we have it we may be sure that someone has planned and wrought to bring it; someone has spent his days in a laboratory to insure its purity; someone is living constantly alert to keep the far-flung mechanism of gathering, storage, purification and distribution in perfect function for at least twenty-four hours out of every twenty-four.

IN the beginning must be vision. The late J. Waldo Smith, himself a rock-smiter of heroic stature, used to tell us that a large city requires ten years of preliminary effort from the conception of a new supply to the date of awarding construction contracts.

Complacent city-dwellers, their needs amply supplied at the moment, must be made to feel the pangs of a thirst ten years or more removed and then, patiently, they must be led through the devious by-ways of politics to vote authority for the initial steps. In turn follow the compilation of essential information and data on which to base studies; legal snarls to be untangled; titles to be searched and acquired; conflicting claims and interests to be reconciled. Legislators must be held constantly by the hand to insure the needful continuity of authority and funds.

Technical research and analysis then must seek out the constants and coefficients required by the engineers to design each separate element in the vital chain of structures, from the reservoir, crib or well-point clear through to the hydrant and house connection. On their plans and specifications contracts are awarded, men and machines are assembled and the constructor's genius is invoked to translate the engineers' conception into substance.

Meanwhile in a thousand drafting rooms, laboratories and shops, more thousands of engineers, chemists and mechanics, servants of water-works manufacturers, are devising and fabricating the vast arsenal of materials and machines required to serve the builders, measure and control the flow of the waters, purify them for human use and distribute them to every point of need.

EVENTUALLY, with the work of shop and field thus integrated into a working whole, enters the staff to maintain and operate it; their task it must be to stand incessant guard lest any link should fail and thereby frustrate the purpose of the whole.

All this, and more besides, just to insure that when John Public turns the tap he surely will find awaiting him the wherewithal to wet his whistle, scrub his hide or put out his fires.

In these days when it is so much the vogue to bemoan the costs and inefficiencies of government, it is just as well to remind the complacent John Public that in every town and city of the land, this little job is going on every hour of the day and night in order that he may continue to have, not only today but also ten years hence, what he takes so blithely for granted.

In respectful tribute to the achievements of American water-works administrators, engineers, superintendents and manufacturers in behalf of the public health and security, this page offers a bow toward the City of the Angels where their representatives now are about to convene to consider their common concerns.

Willard Chevalier

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The RADIAL-CONE Design for Medium Sized Water Tanks

MANY large elevated tanks for municipal service have been built with radial-cone bottoms. The use of this design, however, is not restricted to tanks with capacities of 1, 1½ or 2 million gallons. It can be used equally well to provide a low range in head in tanks the size shown in the accompanying illustration.

The principal advantages of the radial-cone design are as follows:

1. *The range between the upper and lower water levels is low. This reduces the variation in pressure in the distribution system to a minimum.*
2. *The shallow depth of the tank shell reduces the average head against which the pumps must operate and thus cuts operating costs.*
3. *The relatively large diameter and shallow depth of the tank shell gives the structure well-balanced proportions.*

500,000-gallon radial-cone bottom elevated tank for municipal service. It is 95 feet to bottom and has a range in head of only 25 feet between the upper and lower water levels

In addition to the above-mentioned advantages, each radial-cone tank installation gives you the normal benefits of elevated storage. Pumping equipment can be operated at a uniform rate to obtain maximum efficiency. A great deal of the requirements for peak periods can be pumped at off-peak periods when pumping costs and power rates are low. Transmission mains carry average pumping instead of peak demands and do not need to be replaced until average demands exceed their capacity. A gravity supply in elevated storage flows into the system without being re-pumped.

Elevated storage also improves the fire protection which a waterworks system renders. It provides the heavy draft so necessary when a fire department swings into action. It maintains uniform pressure in the mains, even though the operation of the pumps may be interrupted. The improved protection reduces insurance premiums on all property.

We will appreciate the opportunity of discussing the advantages of elevated storage with waterworks engineers. Our nearest office will be glad to tell you if you can use the radial-cone design to advantage or submit quotations on our standard designs to meet requirements. There is no obligation on your part.

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Jack Frost—Road Wrecker—

Reporting from all parts of the country highway officials tell a sad story of winter damages to roads. Next Week and the week following, the details of this damage, whose repair may require $50,000,000, will be presented. Jack Frost, without question, is Public Enemy No. 1 in the road field.

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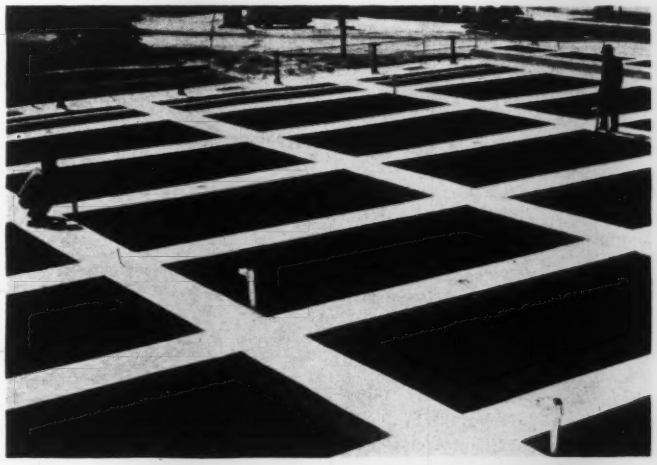
ENGINEERING NEWS-RECORD

ANNUAL WATER WORKS NUMBER

May 28, 1936



MODERN sedimentation basins safeguard quality.

Efficient Water Service

— A Foreword

EVALUATION of the status of our basic public services as we emerge from the depression is one of the first essentials in preparing our municipalities to do their part in the forward march of renewed activity. Waterworks are in this category of basic community necessities and are already being called on to meet the demands of developing prosperity. How these requirements are being or can be met, what means are being utilized to maintain and expedite service—these are the vitally important questions to those concerned with any phase of waterworks today. They find answers in the discussions presented in this issue by leading water authorities, dealing with three outstanding phases of service efficiency—pumping control, system maintenance and quality improvement.

SIMPLIFIED and coordinated control of pumping equipment by means of automatic and supervisory systems is a comparatively recent development. Adapted in part from control schemes used in electric power plant management, these devices have been perfected to meet the specialized and complicated routine operating requirements of water plants. Their application not only increases effectiveness and dependability of operation but has resulted in marked economy.

Eliminating the human element and substituting mechanical robots who unerringly perform their appointed tasks as well as guard against unforeseen emergencies is a revolutionary change in water distribution service. Its future remains to be developed by wider experience. If its advantages can be had everywhere at lower cost both in construction and in subsequent expense for personnel than is normally expended for ordinary service, then it will become an extravagance to maintain the older forms of equipment.

PROVIDING good water service also depends in large measure on improving and keeping system facilities in the best possible condition. The problems of leak detection and repair must be met, cold weather damage must be eliminated, pipe capacity must be maintained, and all appurtenances which play a part in assuring adequate pressure and volume must be kept at highest operating efficiency. System maintenance is a compelling problem.

Finally, after he has provided reliable plant and equipment the purveyor of water must respond to the popular demand for better quality. Taste and odor control and iron and manganese removal must be considered not as an accessory to treatment but as elements in the process of water preparation. Research constantly reveals new methods for rectifying the defects of a water supply, and failure to utilize these is justification for industrial and domestic consumer complaints.

In summary, it is mainly in the application of modernized control, the more efficient maintenance of system and equipment, and in meeting rising demands for quality of water, that the waterworks engineer and official finds his present-day tasks.

Automatic Pumping Stations

BALTIMORE'S water system, pioneer in the use of automatic control, presents outstanding examples of electrical pumping station operation

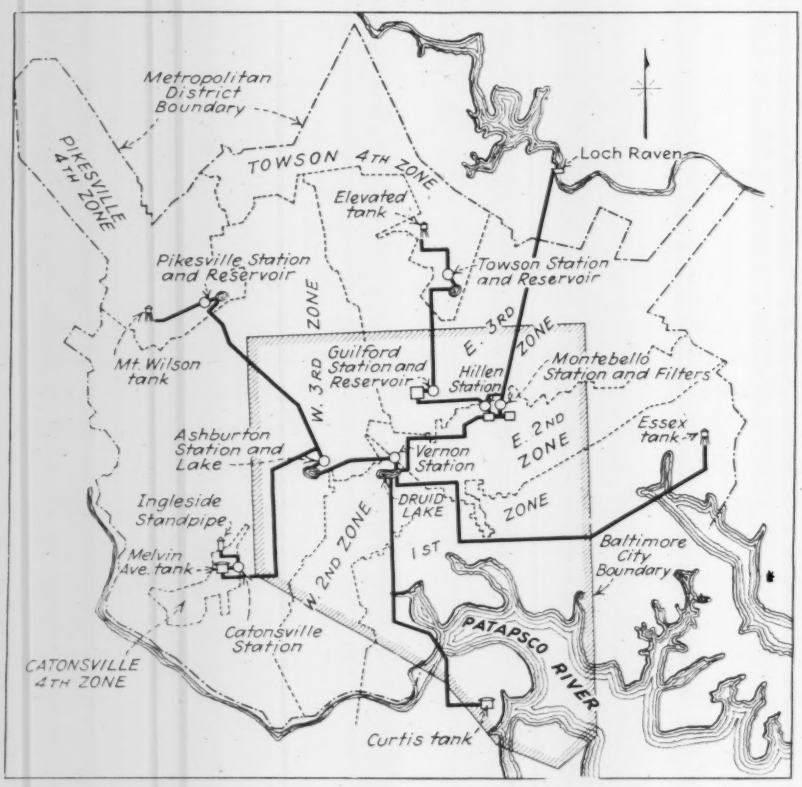
LEON SMALL
Water Engineer, Bureau of Water Supply, Baltimore, Md.

AUTOMATIC control of pumping equipment plays a major role in the Baltimore water supply system, where all but two of the eight municipal pumping stations function without manual attention to guide their operation. This development of highly automatized water service represents the outcome of a recommendation made in 1912, when the annual report of the water department first carried the suggestion to use an automatic electric installation as a means for maintaining the desired levels in a standpipe. From this simple but far-visioned proposal, consistent progress has been made in furthering the application of automatic control to many special requirements of pumping station operation.

Few people not native to Baltimore realize the changes in elevation that occur within the city limits and adjoining territory. These result in pumping taking an important place in the water distribution system. Situated on an estuary of Chesapeake Bay the city has a large part of its business area at an elevation but a few feet above sea level, but the land rises sharply, so that to serve the northern and western portions of the city water storage at El. 567 above sea-level is necessary, and still higher storage is required for areas served beyond the city limits.

Fig. 1 shows in condensed form the general arrangement of the water supply system. The entire supply is taken from Gunpowder Falls, where the Loch Raven Dam impounds a storage of 23 billion gallons at a normal water surface elevation of 240. From Loch Raven a tunnel conveys the raw water to the Montebello filters. The construction of the tunnel is such that the full head available cannot be impressed on it, and this necessitates the use of the Montebello pumping station to lift the water to the two adjacent filtration plants.

FIG. 1—DISTRIBUTION of water in Baltimore requires the use of a number of widely scattered pumping stations, reservoirs and elevated tanks because of variations in topography.



The normal level of the filtered water reservoirs is at El. 213, and from these basins the first zone of distribution is supplied by gravity.

The second zone of distribution supplied by pumping stations taking suction from water delivered to reservoirs serving the first zone, is divided into separate sections for operating convenience. The eastern section is supplied by the Hillen pumping station, which delivers water to the Guilford reservoir at El. 341; the western section is served by the Vernon pumping station, which discharges water to the Ashburton reservoir at El. 340.

The third zone, the highest within the city limits, is cared for by pumping stations located adjacent to the Guilford and Ashburton reservoirs. This zone is again divided into separate sections because of the difference in elevations between the areas served. The Guilford pumps discharge into the Towson reservoir, El. 515, and the Ashburton pumping station delivers water to the Pikesville reservoir, El. 567.

A fourth zone of distribution is needed because of the elevated areas served outside of the city limits. These areas, three in number, represent distinct distribution districts that are marked by concentrations of suburban population at points so widely separated as to justify individual pumping and water storage facilities. They are served by: (1) an automatic pumping station taking suction from the Towson reservoir and delivering water to a tank at El. 600, (2) an automatic station drawing from the Pikesville reservoir and supplying the Mt. Wilson standpipe at El. 700, and (3) the Catonsville automatic station, which takes water

from a local reservoir supplied by gravity from the Pikesville reservoir and delivers it to a standpipe at El. 626.

In connection with the foregoing summary of the distribution scheme of the water supply system it should be noted that, of the eight pumping stations mentioned, but two (Montebello and Hillen), are so arranged that the operator's personnel have an opportunity to exercise their judgment in the management of the equipment. The Vernon station is semi-automatic, the services of the operator being confined to initiating the starting and stopping impulses, all movements of the equipment thereafter being predetermined and beyond his control. The Guilford and Ashburton stations are completely automatic; they are attended at present, but the services of the men on watch are confined to duties of a custodial nature. The Towson, Pikesville and Catonsville station are completely automatic and unattended, supervision over them being maintained by routine inspections and, in the case of the first two, with plans for a like system for the Catonsville station, daily contact it made by means of automatic telephonic supervisory system.

FIG. 2—UNATTENDED AND AUTOMATIC is the Towson pumping station installation located in an underground chamber. The upper view shows the entrance kiosk to the pump room below.

Automatic pumping development

When we consider the little progress that had been made in the adoption of electric power for waterworks pumping twenty-five years ago, it is very interesting to note that in Baltimore at that time not only were electrically-driven pumps being thought of but the ideas along these lines were sufficiently advanced to contemplate automatic operation. Thus, in the Annual Report of the Water Department for 1912, the Mechanical Division, speaking of the insufficiency of a steam-operated station to maintain the water level in a standpipe at times of maximum demands, states: "In order to prevent such a condition, it is proposed to install an automatic electric pumping station at Lake Ashburton, which will come into operation when the water level in the West Arlington standpipe has been drawn down below a certain level." The proposed station was never built, and for several years nothing more was heard of electric-powered pumps outside the offices of engineers engaged on the plans for the Montebello filters.

The Montebello pumping station, placed in operation in 1915, included in its design an arrangement for varying the plant output to suit the requirements of the filters—this is historically interesting because the scheme planned was entirely automatic. The control system was applied to the hydraulically operated valves placed in the pump discharges and was limited to these elements of the pumping equipment, all other portions of the plant being under the manual control of the operator.

Essentially the scheme consisted of a static pressure line carried to the pumping station from a stilling chamber in the filter plant into which the pumped water was discharged, and this line communicated with sensitive devices arranged to operate balanced four-way pilot valves connected to the pump discharge valves; it was intended thus to open the pump discharge valves as the water level in the stilling chamber dropped and reverse the process when the water rose. The system was not a complete success due to the "hunting" that followed each variation in stilling chamber level, but the attempt at automatic control of total station output was indicative of the urge at that time to have machinery perform routine operations.

The next pumping station design embodying automatic control found expression in the Druid station, placed in service in November, 1915. This plant replaced the steam station whose past inadequacy had caused the recommendation three years earlier respecting "an automatic electric pumping station at Lake Ashburton." It is of particular interest to note that while Druid station was designed to be completely automatic in operation, and was equipped electrically to accomplish this, little heed was given to the mechanical and hydraulic features which must be considered in any automatic station if such an installation is to meet the expectations of its designers. Compared to the mechanical and electrical equipment available today to satisfy almost any exacting need for special automatic pump control, the control equipment in the Druid station of 21 years ago was very crude, even though quite advanced for its time.

The control boards consisted of a grouping of electrically interlocked magnet contactors with pneumatic timing of switching sequence, the arrangement being similar to elevator motor controllers and perhaps adapted therefrom. The controlling elements consisted of indicating pressure gauges adapted to serve the purpose of the pressure governors available in so many varied forms today. Under normal static conditions in the distribution system the lowering of the water level in a standpipe supplied by the station would result, theoretically, in a drop of pressure sufficient to cause the "low" contact on the "governor-gauge" to make, thus placing a pump unit in operation until the standpipe was filled, whereupon the "high"

contact would make, shutting down the unit. This arrangement was not the success hoped for, largely due to the rather narrow limits within which the levels in the standpipes were required to be maintained as compared to the heads against which it was necessary to pump. Automatic operation was therefore abandoned for manual control.

In 1918 the city limits of Baltimore were extended so that the former area of 32 sq.mi. was increased to 92 sq.mi. The acquisition of the properties of private water companies, following shortly after the annexation of additional territory, placed upon the Bureau of Water Supply the problem of incorporating into the city system a number of scattered and independent water plants serving the various areas. While some of the former private pumping stations were so situated that they could be abandoned as soon as connecting mains from the city system were extended, several others served areas well above the elevation of the highest levels reached by the city system, and these stations or their equivalent had to be maintained. This condition offered an opportunity again to try the merits of automatic pumping, particularly in view of the fact that the load requirements of the stations were comparatively light, making the labor cost for manual attendance entirely disproportionate to all other operating expenses.

Early difficulties overcome

Accordingly, in 1924 a small completely automatic station was built in the Towson area as an adjunct to a manually operated installation. The location selected was close to the standpipe to be served, which fact permitted using a direct pressure-line connection for control purposes, thus obviating the difficulties that beset the Druid pumping installation of 1915. The success of this station gave encouragement to the building of a similar type of station for the Catonsville area in 1928.

These two small installations (40 hp.) effectively demonstrated the advantages of automatic operation. Accordingly, when the construction of a large station to serve certain city areas became necessary it was decided to make it completely automatic as a normal operating scheme, although susceptible of manual control if this became desirable from the standpoint of distribution management convenience. The Guilford pumping station, placed in service in 1931, and containing two 400-hp. and two 600-hp. units was the result of this decision. Its operating history has justified the belief that entirely satisfactory and dependable automatic pumping stations are not limited in capacity and number of units to small installations.

The formation of the Baltimore County Metropolitan District in 1926, which required further extension of water distribution, resulted in the construction of the present Towson station (to replace the small automatic station ventured in 1924) and the Pikesville unit, both placed in service in the early part of 1932. These stations have had a very satisfactory operating record, due in part to the automatic telephonic supervisory system with which each is equipped.

The latest addition to the ranks of the automatic pumping stations is the Ashburton unit, scheduled to be placed in service in May, 1936. This will replace the 1915 Druid pumping station and, like the Guilford station, will be completely automatic but may be manually controlled should this be occasionally desirable. Its equipment consists of two 600-hp. and two 900-hp. units—greatly in excess of the size of the pumps probably thought of when the Annual Report of 1912 recommended "the installation of an automatic electric pumping station at Lake Ashburton."

Typical station installations

As has been indicated, the automatic pumping stations installed in Baltimore are of two general types: (1) those entirely unattended except for routine inspection at weekly intervals, and (2) those having attendants present at all times but normally exercising no function in the operation of the pumps.

Unattended Type—Fig. 2 is a composite view of the unattended Towson pumping station. The main portion of the station is entirely underground, this disposing at once of all questions concerning the freezing of apparatus during possible long periods of shutdown during cold weather as well as those arising from the necessity for suppressing operating noises if the installation is in a residential section. Normal entrance to the pump room is had by means of a stairwell built exterior to the pump room structure, this terminating in a small brick kiosk above the ground level. A hatchway covered by a removable concrete slab over the pump room provides access for moving the machinery.

The pumping equipment consists of two 1,400-g.p.m. centrifugal pumps, each driven by a 50-hp. induction motor. The pumps take suction from the nearby Towson reservoir and deliver water to an elevated tank against a net head of about 100 ft. The capacity of the pumps is such that but one unit is required at a time to care for the needs of the community served; by means of a selector switch a unit is made the preferred one for a weekly turn of duty, the other unit serving as a standby in the event of trouble developing in the preferred unit, at which time controls automatically transfer the load to the reserve equipment. Duplicate pressure governors, connected through pressure surge damping tanks, serve to start the preferred unit when the pressure in the distribution system at the station drops to a point corresponding to a reduced storage tank level or as a result of excessive draft, such as a fire flow. These governors also shut down the station when an altitude valve at the storage tank slowly closes as the full level is reached, thus causing the pressure in the entire distribution system supplied by the station to rise slightly above normal. Automatic control valves adapted to plain hydraulically-operated valves in the pump discharge lines permit the pump selected for duty to come up to full speed before the discharge valve is opened, and similarly the discharge valve is closed before current is taken off the motor following a shutdown indication. All movements of the discharge valve are set at a predetermined rate, which reduces disturbances on the distribution system to a minimum.

The electric supply circuit after passing through metering devices is branched to duplicate control panels (one for each motor) arranged to protect against the following conditions: (a) undervoltage or improper phase rotation; (b) overcurrent considerably in excess of normal, up to shortcircuit values; (c) overcurrent but little above normal, although sufficient to damage apparatus if long continued; (d) phase current unbalance; (e) incomplete starting sequence.

Except for the first device noted, which merely holds the station equipment inoperative until normal conditions in the power supply lines are restored, all the protective devices when operated lock out the faulty unit, set up a warning target to show what element was affected, and transfer the load to the reserve unit. At the same time they cause a fault signal to show in warning lights placed for this purpose outside the kiosk where the signal may be seen from nearby roads by department employees should they be passing. The fault indication is also set up in the telephonic supervisory system, noted below, ready to tell the news the next time telephone contact with the station is made. Once a defective unit is locked out and the load transferred, the affected apparatus remains out of service until a visit is paid to the station, the trouble corrected, and the control apparatus reset.

Station reports by telephone

A most important and interesting feature of the unattended stations of the Towson type is the telephonic supervisory system by means of which reports regarding the status of the equipment and operating conditions can be obtained at any time through a call made to the station from any local telephone. This arrangement consists of (1) a special relay that performs a function similar to raising the receiver when a call to the station is made, (2) a group of relays and rotary switches connected to the various points from which signals are to be taken, and (3) a buzzer and single-stroke bell for sounding various code signals, mounted in close prox-

imity to a telephone transmitter. A local storage battery with trickle charger supplies current.

When a telephone call is made the automatic equipment responds immediately and codes a signal which describes whether or not the electrical control apparatus is in good order or the nature of trouble if an electrical fault exists. The next signal shows which pump unit has been selected for service, this being followed by an indication as to whether the flow of water in the main supply line to the reservoir from which the station takes suction is influent or effluent with respect to the reservoir, information often desirable from the standpoint of the larger station below which supplies the reservoir. Following, another signal gives the pressure in the discharge leaving the station. Finally there is coded a signal showing the height of water in the adjacent reservoir, this also being of principal benefit to the pumping station below. The entire system of signals is repeated. Then the automatic relay first receiving the call disconnects, terminating a one-sided "conversation" that is as full of meaning to the trained party receiving it as it is vexatious to an exchange operator who attempts to supervise the call. By means of this system of communication from any point, information at all times can be had as to the status of the unattended station.

Attended Type—We will next consider an automatic station of the attended type, the recently installed Ashburton pumping station being typical of this class. Fig. 3 shows a cross-section through this station: An idea of the general dimensions can be obtained by noting that the distance between the centers of crane rails is 28 ft. 3 in.; the inside length of the pump room is 96 ft. The pumping equipment consists of four two-stage series centrifugal units, two of these each having a capacity of 12 m.g.d. against a net head of 225 ft., the others being rated at 18 m.g.d. against a net head of 247 ft. The smaller units are driven by 600-hp. synchronous motors, the larger by 900-hp. motors.

Although the Ashburton station is normally fully automatic in operation it is also designed for manual operation, the judgment of the operator in such cases being confined to giving the initial starting and stopping impulses, while all subsequent functions of the equipment are automatically related and timed. The main switchboard and control table, shown in Fig. 4, is located in a niche in the center of the pump room. An interesting detail of the switchboard layout is presented by the inclusion of venturi meter registers and pressure indicating and recording gauges and other non-electrical elements of station operation as a part of the main switchboard, instead of limiting the latter to electrical functions as in the usual practice. This has the advantage of bringing all the operating indications within view from one point, a factor of considerable importance when the station is handled by manual control and a most convenient arrangement at all times. The control table, which is intended for use with manual operation only, contains hydraulic and electrical control elements for each of the pump units. The operator standing at the table has immediately in front of him a complete picture of the behavior of the unit he is handling.

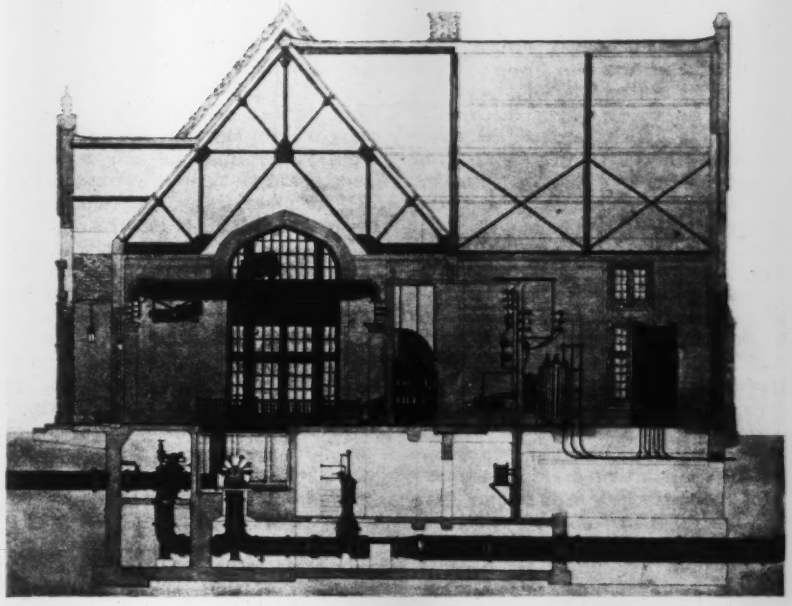


FIG. 3—CROSS-SECTION of the new Ashburton automatic pumping station in Baltimore which was placed in operation this month.

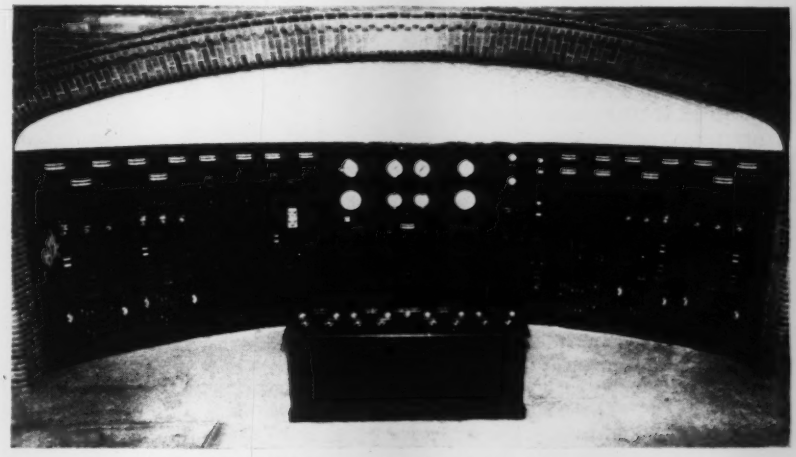


FIG. 4—COMPLETE CONTROL and supervision of the Ashburton pumping station is centered around this elaborate semi-circular switchboard, which includes all the hydraulic indicating mechanism as well as the electrical devices.

As the automatic operating scheme of the Ashburton station is distinctive (although patterned after its successful prototype, the 1931 Guilford station), a brief description of the method of control may be of interest. The pumped water in excess of distribution demands flows to the storage reservoir at the end of the force main until the "full" level is reached. This causes an automatic valve in the main connected to the reservoir to close slowly, with the result that the pressure in the entire distribution system rises somewhat. The pressure rise is limited, however, by a by-pass connection taken from the main ahead of the reservoir automatic valve, the by-pass having a free discharge into the reservoir through a standpipe elevated about 12 ft. above the reservoir "full" level. The pressure increase in the system is reflected at the pumping station, where the rise is sufficient to cause an electrical contact to be made, this in turn resulting in the very slow closure of the pump discharge valve, the

final movement of which in the closing position shuts down the main pump motor. When pumping is discontinued, the distribution demands are met by the reservoir, the supply flowing from the reservoir through a swing check valve located in a by-pass around the reservoir automatic valve; after the reservoir level drops about 6 in., its automatic valve opens, ready for the next operating cycle.

The impulse resulting in the discontinuance of pumping causes a time clock to be placed in service, it previously having been set for a definite time interval sufficient to permit the reservoir level to drop a foot or more during the non-pumping period. At the end of its timing period the clock causes an electrical contact to be made, and this results in the station again going into service; the starting of the machinery places the time clock in the idling position, where it remains regardless of lapse of time until the automatic shutting down of the station again causes the clock to assume its shutdown timing duty. During the timing of the clock which determines the shutdown period, excessive draughts such as a fire flow which result in the static pressure at the station being reduced to a predetermined "low" point can cause a contact to be made that will anticipate the timing period, thus causing the station to be placed in service to meet the extraordinary demands that caused the excessive pressure drop.

From the size and relative importance of the station last described, it is evident that automatic pumping need not be confined to small, remote or perhaps unimportant installations. The application of completely automatic methods of electrical pumping, regardless of size, is principally a question of competent design; there is available a wealth of mechanical and electrical equipment to meet any condition likely to be encountered, and special designs for particular conditions are to be had upon demand. The writer is convinced that the special requirements of pumping that cannot be met by automatic electrical control are indeed rare.

Economies and advantages

The economy of automatic pumping station operation is quite evident, particularly in the unattended type. The savings in construction costs, as compared to pumping stations of the conventional design, are readily discernible from a consideration of the simple housing requirements, but the greatest economic gains are found in the operating sphere. Particularly is this true where the pumping capacities are comparatively small and the salaries of operators are out of proportion to the plant output. In such cases the adoption of automatic pumping yields surprising returns. Baltimore experience with the Catonsville automatic pumping station is illustrative of this: When taken over by the city from the former private company the Catonsville unit was manually operated, this entailing an annual outlay for salaries, etc., of $5,650; heat, light and other incidentals increased the yearly charges for manning the station by about $100. Enlarged and modernized pumping equipment was installed in 1928 at a total cost of $26,470, and the services of attendants were discontinued, at an annual saving of $5,750, which amply justified the improvement that was made even though it had not been necessary from the standpoint of increased supply. Since being placed in service the average annual operating cost of the Catonsville station has been about $2,275, a figure which, compared to the former cost of manning the old station, is indicative of the toll paid by the users of small manually operated stations where automatic operation could be successfully applied.

With respect to the advantages of automatic pumping, admittedly this phase of the subject has controversial possibilities from proponents of manually controlled pumping plants who may take the position that reliability is the prime requisite of all parts of a water supply system, and that no arrangements of self-functioning mechanical and electrical appliances without direct human supervision can satisfy the first essential.

Reliability a major factor

There can be no question that reliability does come first, and anything that might impair this feature should be carefully weighed before acceptance. For this reason the writer would not consider unattended automatic pumping in cases where continuous operation must be maintained—for such a system the writer would be extremely loath to adopt electrical pumping of any kind even with most skillful operators, unless a plurality of independent power supplies from separate sources or local prime mover standby units of adequate capacity were provided. In Baltimore such necessity for continuous pumping does not exist as all water pumped in excess of immediate demands is stored; the smallest water storage facility is sufficient to supply the community served by it for at least 9 hr., and the larger reservoirs contain as much as five days' supply. Under such arrangements a failure of pumping equipment would have to be long continued to affect the continuity of the water supply, a state of affairs that could result only from a complete failure of central office supervision where men, and not machines, would be to blame.

One of the principal advantages of automatic pumping, particularly unattended plants, relates to latitude of design. Having no need to think of the well-being of men on watch, the pumping station may be placed entirely below grade, with the minimum of ground space allowed for entrance purposes. Such a design results in practically a noiseless plant, a fact that permits installation in the midst of residential sections with the assurance that there will be no complaints of operating noises. Again, considered from the standpoint of general efficiency an automatic station can be made much more compact than one in which attendants must move about, and there is no necessity for devoting space to an office, locker room, heating and toilet facilities. Where land is not available or is held at an excessive value in an area where a pumping station is desired, the compactness and underground adaptability of an automatic station readily permits its installation beneath the street surface.

Operating benefits

The foregoing relates to the advantages of automatic stations from the standpoint of design, but the operating advantages are likewise evident in both the attended and unattended types after an experience with them. The pumping machinery, once properly adjusted, performs its functions in a routine manner impossible with manual control. The desired operating scheme for each station can be selected and fixed by one skilled supervisor to yield the best results, he alone being answerable to the administrative authorities if the pumping operations are not satisfactory. In attended stations this relieves the personnel entirely of responsibility for proper plant operation, a condition which apparently is most acceptable to the men. Intimate knowledge of the control scheme in an attended automatic station is not required of the operators, thus permitting attendants to be shifted about among stations regardless of operating experience. In general, the work required of a pumping station is essentially simple—the functions to be performed consist of starting and stopping the equipment in accordance with definite requirements with precautions taken to prevent damage to the distribution system incident to the application and withdrawal of forces of considerable magnitude. Station operators using judgment and skill can control pumping equipment with varying degrees of success; automatic devices properly supervised, can control similar equipment with greater accuracy.

Free Water Ended By Toledo Survey

The city plan commission in some of its survey work has found 1,792 buildings in Toledo receiving water without meters. Findings have been given to City Manager John N. Edy so that the waterworks department may get busy and collect about $10,000 a year more revenue from the free water users.

Pittsburgh's Control System

DISTRIBUTION of water in nine independent pressure zones requires widely scattered pumping equipment which is successfully operated by automatic devices

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AS PART of a comprehensive plan directed toward improvement of its water distribution system, Pittsburgh has been engaged in the installation of new facilities for pumping station control that are of unusual interest. Concurrent with the electrification of pumping equipment, automatic and supervisory control systems have been installed that not only simplify and coordinate many phases of distribution but achieve extraordinary savings in operating costs. The preliminary work has demonstrated the practicability of eventually operating or supervising operations of an entire water system from central office locations.

Distribution problem

The location of Pittsburgh at the confluence of the Monongahela and Allegheny Rivers where they join to form the Ohio River assures it an abundant source of water supply. However, the rugged topography of this part of the country presents a difficult problem in the matter of water distribution. It has been found essential for the proper and safe delivery of water, to establish nine independent pressure zones which are divided into irregular shapes by rivers, deep ravines and valleys. The highest point in the city is less than 2 mi. northeast of the Ohio River and is 670 ft. higher in elevation than the river. There are within the city numerous points on both sides of all three rivers that reach an elevation of 400 ft. above the river level at a distance of not more than 1 mi., and several points attain a height of 500 ft. within this distance.

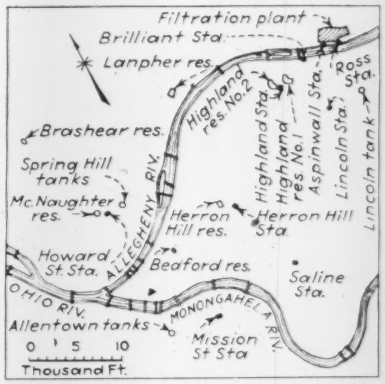


FIG. 1—RUGGED topography requires Pittsburgh to provide a large number and variety of pumping and storage facilities for adequate water distribution.

The raw water supply, totaling about 100 m.g.d., is taken from the Allegheny River and pumped to the Aspinwall filtration plant. From here it is conveyed to distributing reservoirs and tanks located in the different pressure zones, by two pumping systems classified as either primary or secondary.

The primary system includes the Aspinwall steam-operated plant, which pumps filtered water into the Lampher reservoir on the north side of the city, and the Brilliant station, an attended, electrically operated plant that pumps to Highland reservoir No. 1, known as the "high service," and to Highland reservoir No. 2, which is known as the "low service."

The secondary distribution system comprises six pumping stations: (1) Mission St.—a steam-operated plant pumping to tanks; (2) Howard St.—an attended, electrically operated station, pumping to a storage reservoir; (3) Herron Hill—also an attended, electrically operated station, pumping to storage reservoirs; (4) Saline Station—an electrically operated unit provided with supervisory control from Herron Hill and pumping directly into three segregated high areas which were formerly part of the Herron Hill service; (5) Highland—an unattended fully automatic, electrically operated station, pumping into a distant part of the Herron Hill service; and (6) Lincoln station—also an unattended fully automatic, electrically operated station, which pumps directly into the service main with overflow to a storage tank.

The electrification of pumping stations within the last decade has made it possible for waterworks managements to choose advantageous locations for their plants and this has resulted in better utilization of the distribution system and in improved service; the comparatively recent development of supervisory control systems has made it possible and practical to operate or supervise operation of the entire system or related units from a central

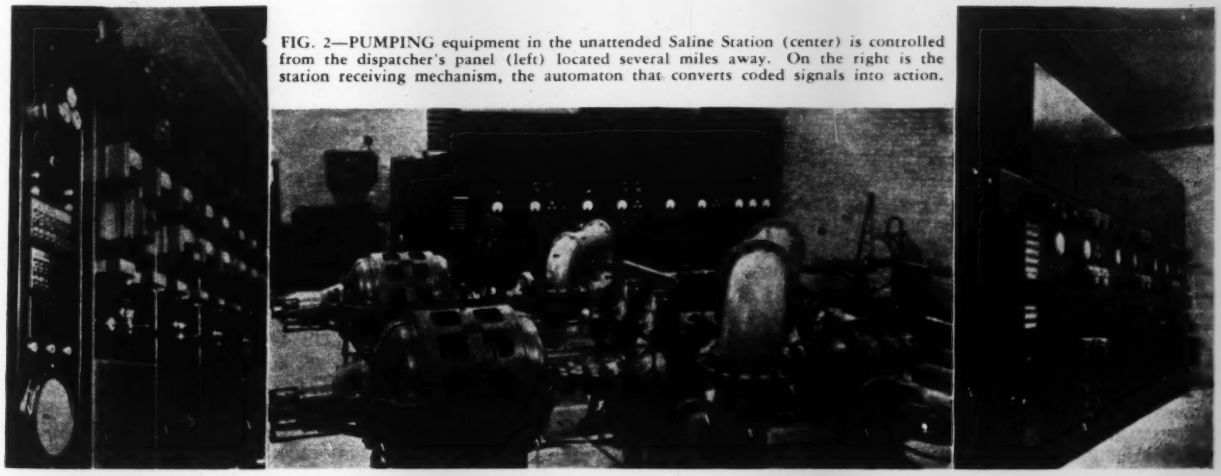


FIG. 2—PUMPING equipment in the unattended Saline Station (center) is controlled from the dispatcher's panel (left) located several miles away. On the right is the station receiving mechanism, the automaton that converts coded signals into action.

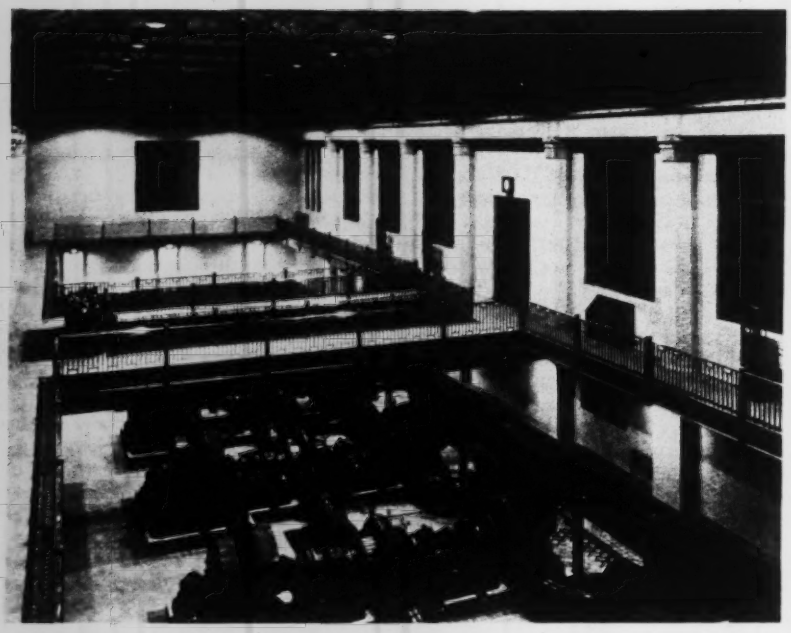


FIG. 3—UNDER FINGER-TIP CONTROL, motors of 12,000 hp. pump water at the rate of 180 m.g.d. at Brilliant Station. The whole operation of the station is directed from the small control desk shown at the left center.

office. While it is true that no two communities have the same problems of water supply, pumping and distribution, the fundamental principles of control used in Pittsburgh are generally applicable in all cases.

Electrically operated plants may be classified as either attended or unattended stations. From a purely technical standpoint the first group may be eliminated, except in a few cases where the cost of operators is justified by excessively complicated equipment. Unattended stations may be either of the automatic or remote-control type, with possible combinations of the two types. Automatic stations are those in which the equipment is started and stopped through relays that are regulated by reservoir levels or system pressures, or by fault in, or failure of, station equipment. Remote-control stations are those in which all or the major part of the equipment is governed by a dispatcher in a distant location; this may be accomplished by means of a direct wire connection or through a so-called supervisory control system.

Audible and visible systems

Direct wire control is practical only for applications over comparatively short distances where a reliable multiconductor cable installation can be maintained at low cost. It requires that all control circuits be extended from the operating switchboard to the receiving equipment. Supervisory control systems, on the other hand, operate and indicate over a few wires, usually one two-wire telephone circuit. With this latter system, two distinct types of equipment are commercially available, either the audible or visible mechanism.

The audible type of supervisory control employs a dispatcher device similar to the conventional dial telephone, through which the remote control equipment is selected and sends out coded signals consisting of a certain number of combinations of impulses. These are transmitted to the supervisory relays at the receiving station and each coded signal sets up a combination of relays corresponding to the desired selection or function of equipment. After the equipment has gone into operation return signals come back to the dispatching office as buzzer sounds corresponding to the original selection signals; an alarm is sounded should an automatic operation in the station change the position of the operating equipment. This alarm is essential to successful use of an audible system.

The visible type of supervisory control is quite similar in its function but in place of audible signal, indicating meters and minature lights on a panel board present a continuous picture of operation. The dispatcher's equipment is usually in the form of desk apparatus comprising control switches, indicating lamps and meters. The impulses are transmitted to the receiving station but the proper combination of signals is automatically established merely by pushing a control button.

The choice between these two systems depends entirely on local conditions. While the audible type has the advantage of low first cost, the visible system is much faster in operation than the audible system.

In connection with supervisory control of water pumping stations, it is necessary to mention the development of remote metering equipment, because few applications of this type of control would have been practical or possible without reliable means of ascertaining the water conditions at distant points of the system. Many forms of such devices have been placed on the market, but only in the past few years has it been possible to obtain mechanisms which are sufficiently suitable in design and rugged in construction to be confidently accepted by the waterworks engineer. The use of time as a measuring unit eliminates inaccurate readings, and the adaptability of the equipment to transmit any information desired, be it either flow, pressure, voltage, or any other form of metered energy, as well as the fact that one may use any chosen type of electrical energy for the transmittal of the measuring impulses, makes this form of equipment of inestimable value in the improvement of water distribution systems.

Protection against faulty operation

Considering the magnitude of forces at play in a water system of even moderate proportions, it is of utmost importance to detect faulty operation which, if not checked and remedied, might result in destruction of pipelines and stations. In the design of new stations at Pittsburgh, the following protection of equipment is provided:

1. Induction relays protecting against short-circuits and overload caused by excessive pump load.

2. Relays to guard against: grounding of equipment before a fault develops into a short-circuit, voltage failure, unbalanced operation or phase failure on synchronous motors, and open motor field or exciter failure.

3. Timing relays to prevent continued operation of synchronous motors as induction motors when electrical disturbances prevent synchronous operation.

4. A relay to remove the direct current field in synchronous motors when the motor drops out of step, and to again apply it when "near synchronous" speed has been attained, or after a definite time delay.

5. Bearing thermal relays on all motor and pump bearings, usually adjusted for 160 deg. F. for anti-friction bearings and 190 deg. F. for sleeve-type bearings.

6. Limit switches on the automatic cone type check valve of pump discharges. These are arranged so that they will trip the motor in case of faulty valve operation.

7. Lockout relay—this is operated by such faults as will require mechanical or electrical repairs to the equipment before restarting. These faults are: overload, short-circuit, ground, hot bearings, field failure, and failure of discharge valve control.

All relays, including lockout and bearing thermal relays, are provided with operation indicators in the form of annunciators, which drop a target after an

operation, so that the inspector can locate the faulty part at once.

In connection with protection of equipment, water valves play an important part. The rotary cone type is particularly well adapted for automatic station application since it can be operated at adjustable speeds by electric or hydraulic motor and it provides protection in case of power failure or automatic shutdown which was impossible to obtain with the old type of check valve. That such protection is necessary can be appreciated when it is considered that the surge wave in pipes may reach velocities of 3,600-4,200 ft. per sec., which adds pressures of 50-250 lb. above normal operating pressures. To prevent the pumps and station piping, as well as the outside pipelines, from being subjected to such excessive pressures, hydraulically operated rotary-cone valves have been installed at Pittsburgh. They have been efficient and reliable and fairly easy to adjust for proper timing of opening and closing strokes. The proper timing is, of course, essential for protection against surges and waterhammer.

Application of station control

Specific illustrations of modern pumping station control are exemplified by the work carried out in the 1935 program of the Pittsburgh water department with the electrification of the Herron Hill pumping station, the modernization of the Lincoln station, and the construction of the Saline and Highland pumping stations.

The new Saline pumping station is an example of a supervisory control unit intended for continuous operation in pumping to a high area (Squirrel Hill) previously supplied from the Herron Hill station. Due to an inadequate distribution system, satisfactory pressures could not be maintained in the high area. In 1931 the city installed a 7½ m.g.d. electrically driven centrifugal pump at Herron Hill pumping station to pump directly to the distribution mains in the high areas of Squirrel Hill district. While fair improvement resulted it was found impossible to give satisfactory service to all parts of this district except by the construction of larger mains, at an estimated cost of approximately $500,000, or by providing a separate pumping station for direct service to the high areas of the district. The latter was the more economical scheme and the Saline pumping station was constructed and located in the opposite end of the district from the Herron Hill station. The new station receives its supply from Highland reservoir No. 2 through a 50-in. steel line which also feeds the South Side district at an approximate rate of 12 m.g.d.; only a negligible increase in friction loss in this line is caused by the Saline demand.

Saline pumps directly into a segregated system, supplying the maximum demands of the Squirrel Hill district at a continuous normal rate of approximately 4 m.g.d. The water not used in this system is discharged through a pressure-regulating altitude valve to lower parts of the system or reservoir storage. Check valves are provided between this system and the lower parts of the district so that the higher areas may be served from Herron Hill, where the 7 m.g.d. high-pressure pump is maintained for standby use in case of emergency outage of the Saline station.

Saline station is equipped with 3 pumping units, each consisting of two single-stage centrifugal pumps in series, and driven by synchronous motors at 1,800 r.p.m. Units 1 and 2 are 10x8-in. pumps, each unit delivering approximately 3,000 g.p.m. at a total dynamic head of 365 ft.; unit 3 is a 6x5-in. pump, delivering approximately 1,200 g.p.m. at a total dynamic head of 400 ft. The normal dynamic discharge pressure is about 520 ft., or 80 ft. higher than static discharge pressure. Each unit has a hand-operated gate valve on the suction side, and two hydraulically operated rotary cone type valves on the discharge side; these latter are controlled by 220 volt a.c. solenoids which are energized and deenergized through the auxiliary switch on their respective motor breakers.

Duplicate rotary cone valves were installed for additional safety in case of failure of one valve to close when the unit is stopped. In addition to this safety feature, a balanced disk check valve of special design has been installed in the discharge line about 3,500 ft. from the station, so that the water stored in the discharge line between this check valve and the suction pressure level will be limited to about 7,000 gal. The high discharge head at which this station is operating, plus the fact that the station is unattended, made it necessary to provide these unusual precautions for positive protection of equipment.

Under normal conditions only one of the 3,000 g.p.m. pumping units is in continuous service. The 1,200 g.p.m. unit is used during periods of drought or other high-demand periods, and it would not be in service for more than one or two months each year.

The electrical equipment consists of three main parts:

1. 4 kv. switchboards.
2. Station service equipment.
3. Supervisory control equipment.

The 4 kv. switchboard is of the conventional cubicle type, with all parts interlocked to prevent accidental contacts with high-tension parts. One cubicle contains the 4 kv. main service breaker equipment, and one cubicle for each of the three motors contains motor feeder breaker, starting resistors and resistor shortcircuiting breaker. All breakers can be operated electrically from the switchboard, but only when the operation selector switch on the supervisory receiving panel is set for "local" operation.

The supervisory control is of the visual type, employing lamps to indicate the position of the controlled equipment at all times, and to notify the operator of correct or incorrect selection during operation. It consists essentially of dispatcher's equipment located at Herron Hill, and receiving equipment located at Saline. These are connected through a standard telephone circuit, rented from the telephone company. A duplicate circuit is rented for emergency purposes.

Method of operation

The system operates by transmittal of coded signals, functioning at 48 volts d.c., each consisting of a definite number of impulses of equal duration. In this respect it is quite similar to an automatic telephone system, except that the required number of impulses for each selection or operation is set up automatically by pushing a single button or turning a key. Each signal operates a corresponding relay in the receiving equipment, either selecting a "point" or operating the selected "point" connected with an oil circuit breaker, valve control, or some other control mechanism. For example, to close an oil circuit breaker, the operator presses the selection key for that unit; this causes a code to be transmitted to energize the corresponding selection relay at the receiving equipment.

Operation of the selection relay causes the same code to be returned to the dispatcher's equipment, thereby energizing a relay and lighting a white selection lamp which indicates that the proper relay has been selected. The operator now presses the "master" control key, causing a code of six impulses to be transmitted to the receiver, which then completes the circuit and closes the breaker. When the breaker closes, the auxiliary switch on the breaker changes the position of the point relay, thereby sending a code of six impulses to the dispatcher's equipment, whereupon the indicating lamp changes from green to red; this signifies successful execution of the desired control. Other operations, as well as indications of automatic operation of equipment in the remotely operated station, are completed in a similar manner, except that an alarm is sounded on the dispatcher's panel whenever equipment or conditions at the distant station are automatically changed. To stop the alarm, the operator momentarily depresses the "Reset" button, opening the line circuit and restoring the supervisory equipment to its normal position.

The dispatcher's equipment consists of a vertical steel panel, on which are mounted escutcheons for control of the 4 kv. main breaker and the three pump motors, supervision of the voltage on

the three phases, supervision of suction pressure, and supervision or indication of whether the entire equipment is connected for "local" or "supervisory" control. It also contains a "check" key for the purpose of checking any point or to start the sequence of checking all points consecutively. In case of a fault in the transmitting circuit or equipment, an alarm will ring, and an amber alarm lamp will light, if the fault is an open circuit or equipment. When such a fault occurs, the operator transfers the entire equipment to the spare transmitting circuit by depressing the telephone selector button, and the transfer at the receiving end is completed automatically.

Since the indicators on the dispatcher's panel definitely record every activity, it has been possible to make a complete tabulation of all fault operations. The operator notes the indications and from his tabulated chart may obtain full information, not only as to the nature of the fault but also as to what operation he should make and to whom he should send notification of the fault.

The cost of the entire supervisory control equipment was approximately $4,000; the dispatching and receiving equipment come completely wired as self-contained units from the manufacturer, consequently the cost of their installation and connection is negligible. The total cost of providing supervisory control is, therefore, less than the cost of maintaining an operator (on each shift) for one year.

One attendant at Herron Hill

The Herron Hill station, located in a residential district, was built in 1895 to serve as a secondary pumping unit to lift water from Highland No. 1 reservoir, to Bedford and Herron Hill reservoirs. It was equipped with vertical triplex engine pumps and gasoline boilers. Numerous complaints of the pulsating noise transmitted through the water mains, together with the high cost of operation and difficulty in maintenance, finally resulted in approval for electrification which, incidentally, has been estimated to save the city approximately $35,000 yearly in operating costs.

Six modern centrifugal pumps, driven by motors ranging in size from 75 to 550 hp. and totaling 1,775 hp., have been installed. The switching and control equipment is of the most modern type, and full protection is provided against any faults in electrical and pumping equipment. Only one attendant on each shift is required for operation of this station. This same attendant operates the Saline pumping station by means of supervisory control.

Equipment and control in the Herron Spring pumping station is so designed that the entire station can be controlled from a remote point by the addition of a simple supervisory control system.

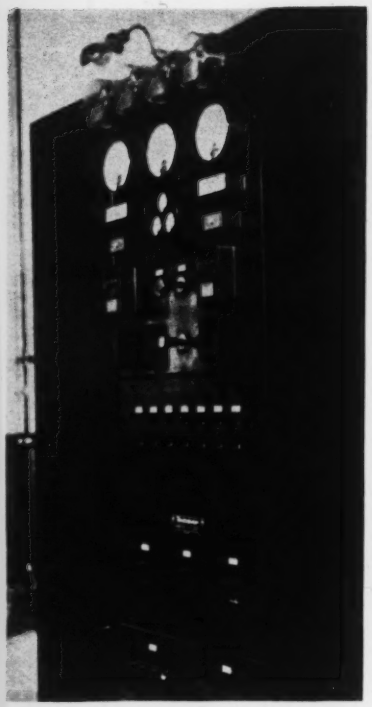


FIG. 4—AUTOMATIC starting and stopping equipment in the unattended Lincoln Station. Two pumping units connected to a standpipe and also directly to the distribution mains are regulated by pressure and demand changes.

The Lincoln station is unattended, supplied from Highland No. 1 reservoir, and pumps to the Lincoln storage tank through a rising main which is connected to the service mains. Originally built for steam operation, it was electrified in 1923, and equipped with two 1 m.g.d. centrifugal pumps. Operators were maintained at the station at a cost which was entirely out of proportion to the duty of the station, considering that the average daily output was less than 750,000 gallons delivered at a total dynamic head of about 300 ft.

In April, 1935, the old equipment was removed, and replaced with two new pumping units and a modern control board. Each new unit consists of a single-stage pump, operating at 3,520 r.p.m., and delivering about 860 g.p.m. against a discharge head of 350 ft., the suction head being about 60 ft. Each pump is driven by a 100 hp. motor, operating at better than 94 per cent power factor. It is worthy of note that the efficiency of these new pumping units is about 80.9 per cent wire to water, the pump efficiency being 86.8 per cent and the motor efficiency at normal operation 93.3 per cent. This high efficiency resulted in yearly power cost reduction from $5,200 to $3,600.

All control and starting equipment is contained in a compact steel cubicle switchboard. By means of a selector switch, either one of the two units may be selected as preferred unit for normal operation, and it will remain in operation until some fault such as bearing trouble, overload, or fault in the automatic rotary type discharge valve control operates the lockout relay, thereby stopping the motor and automatically placing the other unit in operation. The faulty unit cannot be started again until the lockout relay has been reset by hand.

Pressure governs pumping

The automatic starting and stopping of the pump units presented an interesting problem, due to the fact that the rising main and the distribution lines are interconnected. It was desirable to start a pump whenever the level of the tank, located about one mile from the pumping station, dropped to about 12 feet, or when an unusually high water demand occurred in the district. This latter condition would prevail in case of a fire, when it would be desirable to start a pump at once to create ample pressure and provide sufficient water for reserve storage in the tank. When a pump is first started it should not be stopped until the tank is nearly filled, or at about the 20-ft. level. The dynamic discharge pressure corresponding to a 20-ft. tank level varies about 3 lb. from day to night, the highest pump discharge pressures occurring at night, when the friction increases during low consumption. If the pumps were controlled through a pressure relay at the pumping station, the high tank level would consequently vary about 7 ft.; this would result in too small a differential between low and high level to assure good operation.

The final arrangement, which has now been in satisfactory operation for more than six months, consists of a standard low- and high-pressure relay at the station, in connection with a pressure relay located in a manhole on the rising main about 500 ft. from the Lincoln tank; this latter relay is connected through a rented telephone circuit to the station switchboard, and when the tank level reaches 20.5 ft. it closes the circuit and operates a telephone clapper-type relay on the station switchboard, thereby energizing the heater unit of a bi-metal relay. A so-called snubber switch stops the operating units after a delay of about 2 minutes. The high-pressure stop relay at the station is maintained in the control scheme, providing a double stop relay as follows: During the day, when dynamic discharge pressure is low, the tank relay stops the pump at 20.5-ft. tank level and, in case of failure of the tank relay, the station relay will stop the pump at about 23.5-ft. level. During certain night hours the station relay will stop the pump at about 17-ft. tank level and, in case of failure of this relay, the tank relay will operate at

20.5-ft. tank level, thus providing a duplicate shut-off operation.

The station is wholly unattended, but it receives a daily inspection by a division electrician. The elimination of operators represents a yearly saving of $6,800. This saving, added to the decrease of $1,600 in power cost, or a total of $8,400, will repay the entire cost of new equipment and construction, totaling $10,000, in about 15 months.

Highland pumping station

This station was constructed as a local booster station to provide adequate pressures in the Highland Park, Stanton Heights and Garfield districts, located at a considerable distance from the Herron Hill reservoir, from which they are served by a single pipeline which has not maintained satisfactory pressures during periods of high water demand. The installation includes two single-stage centrifugal pumps, each delivering about 730 g.p.m. at a total dynamic head of 218 ft., and driven by a 60 hp. motor at 3,520 r.p.m. The normal unit efficiency wire to water is 77.9 per cent.

Electrical switching and control equipment are similar to that provided for the Lincoln pumping station, except that the automatic start and stop equipment is omitted. The station is unattended and one unit is in continual operation at all times.

The station deserves mention primarily on account of its attractiveness, a specially desirable feature in a utility structure located in a residential district. The architectural refinement was added at a comparatively small cost, and the entire contract price for excavation, foundations, building and grading was only $6,630.

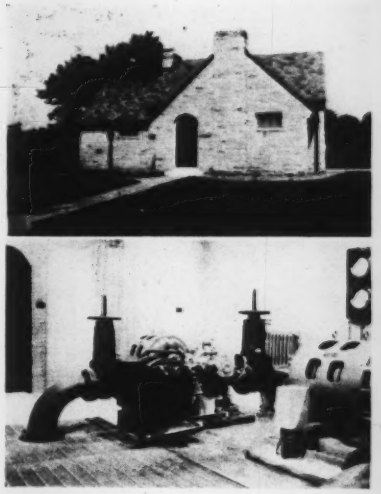


FIG. 5—RESIDENTIAL housing for two centrifugal pumps. The Highland Station is completely automatic even to gas-fired heating radiators that are thermostatically controlled by temperature variation.

The increasing use of electrically operated pumping stations and the rapid development of reliable and sturdy equipment for automatic and remote control indicates that the time is not far distant when municipal waterworks may adopt a form of "system operation and control" similar to those that have been so successfully applied by the electric power utilities. The extended use of automatic stations with remote indication and of supervisory control plant makes it practicable and economical to concentrate the supervision and operation of all stations at one central point, where technically trained dispatchers are continuously on duty.

A distinct advantage of this type of system is the possibility of better utilization of present distribution systems, with resulting improved service, obtained by operating small booster stations in the most advantageous locations rather than attempting to combine several stations in one location for the purpose of economizing in the cost of operators.

Such a centrally controlled system, supported by intelligent inspection and maintenance, is by far a better safeguard of service and equipment than the old type of operation where the number of operators and the degree of skill required was determined not by the needs of the service but mainly by the political influence of the operator's organization.

Acknowledgment

The Pittsburgh Water Works is a bureau under the jurisdiction of the Department of Public Works. Leslie M. Johnston is director of public works, and the policies inaugurated by him have been largely responsible for making possible the modernization of the waterworks plant. The Bureau of Water is under the supervision of James H. Kennon, managing engineer, and the writer is in charge of design of electrical equipment and control installations.

Operating Distant Wells

OPERATION of a well field 4 mi. from the treatment plant is guided by telephone-type supervisory devices—Indicating meters grouped at central location aid in the coordination of various plant functions.

D. L. ERICKSON
City Engineer, Lincoln, Neb.

REMOTE control of well pumping in the water supply system for Lincoln, Neb., has not only demonstrated its effectiveness in simplifying operation since its installation in 1933 but proved of unusual value this past winter when heavy snow prevented access to the well field for an extended period of time. During the month of February the roads leading to the wells, some of which are 4 mi. from the treatment plant, were entirely blockaded and without remote control equipment it is doubtful that operations could have been continued.

The new supply works constructed in 1933 (*ENR*, Apr. 20, 1933, p. 487 and Feb. 14, 1935, p. 246), consists of seven wells, an iron and manganese removal plant and a pumping station located in the Platte River valley not far from Ashland.

A 36-in. pipe line conveys the treated water to Lincoln which is 25 mi. away. Each well is equipped with an electrical-driven deep-well turbine pump with a capacity of 2 m.g.d. The treatment plant and pumping station have a maximum capacity of 13.5 m.g.d. The nearest of the seven wells is about 2 mi. from this pumping station and the farthest well is approximately 4 mi. distant.

Method of operation

All operations of the supply works are controlled from the pumping station. The deep-well turbine pumps are governed by means of telephone-type automatic supervisory equipment which permits starting, stopping and checking every operation of each well.

The dispatching device (Fig. 2) is of the audible indicating type and by merely dialing certain combinations on a standard telephone mechanism, relays are actuated and a variety of operations can be initiated. Within short time after the operating sequence has been transmitted a buzzer returns an announcement in coded signals which indicates

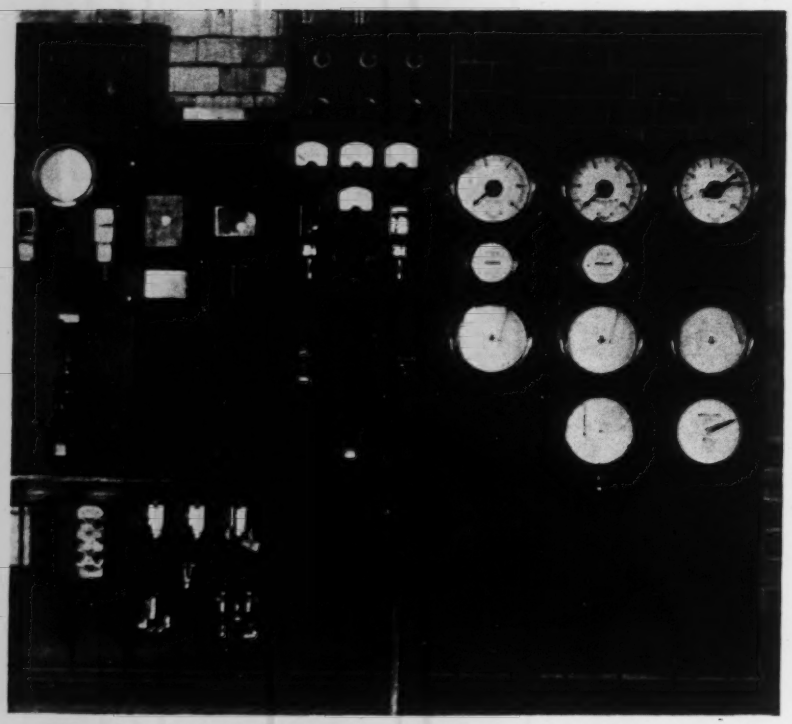


FIG. 1—INDICATING METERS (right) guiding the operation of all plant units are grouped together and thus facilitate control. The automatic starting equipment is mounted on the panels to the left.

FIG. 2—DISPATCHING equipment at the Lincoln, Neb., water supply plant which starts, stops and checks the operation of seven wells located 4 mi. away.

whether or not the pump is functioning. Only one 2-wire circuit is used between the well field and the pumping station.

A standard portable telephone set is used in addition to this system in order to provide a means of voice communication between the two points.

In order to exactly balance well pumping with the pumping from the main station at Ashland into the 25-mi. 36-in. pipe line to Lincoln, one of the wells is equipped with a turbine pump with eight different speed variations. The exact speed of this pump is also subject to regulation by means of the automatic supervisory-control equipment. Ordinarily, only half of the wells are needed at any one time so that it has been the practice to rotate the well operation about six times each day by starting and stopping various units. This is entirely controlled by the attendant at the Ashland station. As a routine detail the wells are visited once each eight-hour shift and checked for mechanical condition.

It is of interest to report that the adequacy of the well house heating system was demonstrated even though the temperature got as low as 29 deg. F. below zero. This heating system, consisting of a thermostatically controlled electric strip heater mounted inside of each well house, is so adjusted that the current cuts in when the temperature inside the well house reaches 40 deg. F. The heater was designed to maintain this 40 deg. temperature when the outside temperature is twenty deg. below zero.

Central location of meters

The pumps in the Ashland station are the horizontal centrifugal type driven by three-phase synchronous motors with full automatic starting. The starting equipment for these motors is mounted on a panel located on a mezzanine floor above the pump room. (Fig. 1.)

Alongside the motor panel there is a hydraulic instrument panel on which are mounted the following instruments:

1. A well flow meter of the indicating, recording and totalizing type which measures the water coming from the wells to the pumping station. This meter is of the orifice plate type with the meter body set in the well pipe line approximately 200 ft. from the pumping station; the orifice head differentials are transmitted electrically to the panel instruments.
2. A venturi type meter also of the indicating, recording and totalizing type, which measures the water leaving the pumping station after treatment in the iron and manganese removal plant.
3. An indicating Selsyn depth gauge to record the level of the water in the 3 m.g.d. equalizing reservoir located between the iron and manganese removal plant and the pumping station.
4. An indicating depth gauge that gives the level of the water in the clear well of the iron and manganese removal plant.
5. A recording gauge to indicate the level of the water in the wash water tanks of the iron and manganese removal plant.

The installation of automatic starting equipment, the remote control of well operation and the grouping of all recording instruments in a central location, has made it possible to operate the Lincoln supply system with great ease. Only two men and a chemist are needed during the day and one man is sufficient on each of the other two shifts.

Chloramines Keep Pipe Clean

A 63,000-ft. 24-in. pipe line connecting Hinchley storage reservoir to the distribution system of the Consolidated Water Co. supplying Utica, N. Y., in years past has had to be cleaned of algae growth, every 12 to 24 months to maintain its carrying capacity. Late in 1933 J. Walter Ackerman, chief engineer and general superintendent, started dosing the line with chloramines in an effort to control bacterial growths.

After a cleaning early in 1934 the pipe resumed its normal capacity, C in the Hazen-Williams formula rising from 105 to 150 and has stayed at the value of approximately 142 since that time. It is expected that this treatment will continue to be highly beneficial in maintaining pipe capacity.

Leakage Surveys

WITH a trained staff of 250 men engaged in locating and stopping underground pipe leakage Chicago has developed a survey plan that results in water savings averaging 17 m.g.d. each year—Leaks located by dye method

J. B. EDDY
Engineer, Water Pipe Extension, Chicago

ONE OF THE essential factors in maintaining adequate service pressure is to preserve as nearly as possible the original tightness of a water distribution system. To accomplish this purpose the city of Chicago has for a number of years utilized a permanent staff of engineers and mechanics who are specially trained in the technique of locating and stopping underground pipe leakage. District surveys are made regularly and the principal methods for locating leaks involve the use of acquaphone detectors and a dye test that has been developed by the department engineers and applied with great success. In addition to this underground work, examinations of all inside plumbing fixtures are periodically made by plumbing inspectors cooperating with the engineering forces.

Underground leakage surveys, resulting in an average water saving of 17 m.g.d. per year, have not only afforded appreciable immediate financial return but also play an important part in deferring expenditures for plant extensions. In addition, regular maintenance costs are reduced because every leakage survey includes an inspection of all valves, hydrants and service pipes on the mains tested and thus defects are uncovered and can be immediately remedied.

During the past four years an average personnel of 250 men has been employed in Chicago on this useful and highly profitable work. The following account describes the methods used and the results that have been accomplished.

Surveys and organization

District surveys, usually covering an area of about 160 acres, are made periodically to determine the characteristics of flow. When the area to be surveyed has been defined all valves along the boundary of the district, except one or two, are closed and water measuring instruments are installed on the supply pipes feeding the district. A continuous flow record is then made for a period of one to seven days depending upon the character of the district occupancy. From the record thus obtained the average maximum and minimum daily rates of flow are determined. In districts that show a high minimum night rate, subdivision tests are made to localize the flow. These tests show whether excessive flow is confined to one locality or scattered over the entire district, thereby indicating those sections which should be given immediate attention. A complete record of surveys made during recent years covering the entire city is on file in the Bureau of Engineering and serves as a guide in determining where intensive leakage and waste surveys are needed most.

In order to locate and stop underground street leakage, tests of isolated sections of pipe are made to determine the amount and location of the leakage. The field party used in this work consists of a junior engineer, a calker (or plumber), two or more laborers, with a chauffeur and a one ton truck. The field party is responsible only for the tests by which the leakage is measured and located—the preparation of a section for the leakage test and the work repairing the leaks are carried out by the regular maintenance forces. The engineering and maintenance forces are under one division control, both reporting to the Superintendent of Water Pipe Extension.

There are fourteen engineering field parties now employed in locating and stopping underground street leakage. The average daily personnel consists of 22 engineers, 5 assistant foremen, 44 calkers or plumbers, 2 bricklayers, 169 laborers and 20 trucks.

Location of leaks

The two principal methods by which underground leakage is located are the aquaphone and rod, and the dye method. The use of other methods, such as the electric leak locator and the "cut and try" procedure of cutting a valved section of pipe into smaller sections until the leak is further localized within a short length of pipe are not recommended. This latter scheme is tedious and entirely too expensive and therefore never used. The electric leak locator, which is but a variation of the aquaphone, is unsatisfactory because it is too sensitive. This instrument transmits sounds from various sources, thus making its application difficult in congested traffic areas; its use has been limited to the outlying districts,

FIG. 1—LEAKAGE SURVEYS uncovered these specimens of cracked and corroded water pipe in Chicago.

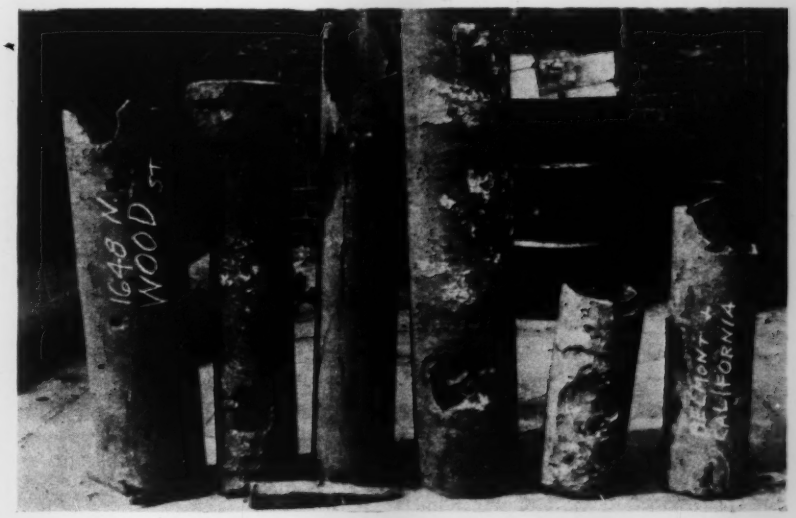


FIG. 2—DYE INJECTED into mains with this pressure tank colors the water for leak detection tests.

and there generally during the night hours.

Two kinds of leakage tests are made in Chicago—the "open" and the "closed" procedure. The "open" test is made without shutting off the services at the stop cock or meter. The aquaphone is applied to every available point where contact with the main is obtainable; every hydrant, valve, service or other appurtenance is sounded. This type of survey has been used quite freely in the city for many years and is particularly apropos when cold weather conditions do not permit the shutting off of services. It is also used during other seasons where local conditions are favorable.

During the past four years 266 mi. of mains have been covered by aquaphone surveys, most of the work being done in outlying residential sections where mains are of normal depth and of comparatively recent construction. In a number of these sections, where the aquaphone survey indicated underground leaks, a "closed" test was made to verify results. In every case it was proven that the "open" test showed all measurable leakage.

In applying the "closed" test, a section of main is isolated by closing the gate valves at the ends of the section and cutting off all service pipes at the stop cock at the curb or at the meter. The leakage, if any, is measured with a 1- or 2-in. meter on a by-pass connection around one of the closed valves. If the leakage is too large to be measured through the by-pass connection with a 2-in. meter the connection is

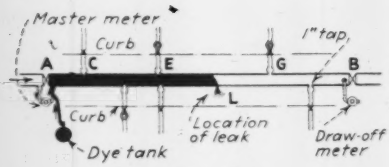


FIG. 3—LOCATION OF underground pipe leakage is a simple but accurate procedure with the dye method developed by Chicago water department engineers.

removed, one valve is opened and a velocity measuring instrument installed. When shutting off the valves and stop cocks, a sounding rod and aquaphone are used to determine if the sound of leaking water can be detected. This "closed" type of test eliminates the confusion that arises from numerous plumbing fixture leaks, underground leaks within premises, wilful waste of water through plumbing fixtures (usual when the service is not metered) or when water is used freely for cooling purposes. All of these "telegraph" their sounds to the man in the street trying to locate leakage with an aquaphone.

In both the "open" and "closed" tests aquaphones are applied to rods which are driven down at various points in order to obtain contact with the water main below. This method has given satisfactory results for many years in outlying districts where the mains are at the normal depth of from 5 to 6 ft. In those parts of the city where the mains have excessive cover or where utility conduits are numerous the aquaphone and rod are seldom used. This equipment is also unsatisfactory where sounds from various other sources interfere; leaks that are water bound are seldom heard, and under certain conditions where there is a full discharge from an orifice the sound is very faint.

The dye test

Where a leak cannot be heard with the aquaphone or where other unfavorable conditions exist, the dye method is used. This test was developed in Chicago by the engineers of the Water Pipe Extension and may be described as follows:

After a section of main has been isolated as in a "closed" test, a harmless vegetable dye (Fuchsine) which colors water red is injected into the pipe. This dye is contained in a tank under sufficient pressure so that it can be forced into the main under observation. The rate in ft. per min. at which the colored water in the main is moving can be determined by considering the cross section of the main and the volume of water being recorded by the master meter on the by-pass of the closed valve.

Referring to Fig. 3, we can assume a section of 8 in. main (*A-B*) is 600 ft. long and has gate valves at *A* and *B*. The leakage in this main is measured by the master meter as in a "closed" test, with all service pipes shut off either at the curb cock or meter. Assume that the leak is at *L*, a point 400 ft. from *A*, and that it amounts to 30,000 gpd., the equivalent of 2.8 cu. ft. per min. The area of an 8 in. pipe being 0.35 of a sq. ft., the average velocity of the water in this pipe is computed at 8 ft. per min. (2.8 cu. ft.÷0.35 sq. ft.). When the valve on the tank is opened the dye colors the water that passes through the master meter. The water in the pipe between the point of injection at *A* and the point of the leak *L* will be colored, while the water from *L* to *B* will remain clear. The dye is fed into the pipe at *A* over a period of time sufficient for it to reach the other end of the pipe *B*. (In this case 75 min.—length of the pipe in ft. divided by the average velocity in ft. per min.)

Volume converted to distance

After 75 min. have elapsed the clear water in the pipe between *L* and *B* is drawn off at the 1 in. tap at *B* through the draw-off meter. As this water is being drawn off the colored water in section of pipe (*A-L*) will flow towards *B* until all the clear water in section (*L-B*) is drawn off, at which time the colored water will appear at the draw-off meter. The reading on the draw-off meter is therefore noted at the beginning of the draw-off and again when the first trace of colored water appears. This volume of water is converted into lineal feet of water in the pipe, which represents the distance in feet back from *B* to the leak. Theoretically in this case 70 cu. ft. of clear water would be drawn off, which would represent 200 lin. ft. of pipe. Actually, however, only about 60 cu. ft. of water would be drawn off on account of the ratio between average and center velocities which is usually about 0.85. Therefore, the actual quantity of water drawn off is divided by 0.85 and the resulting figure, converted into lin. ft. of pipe, gives the actual distance from *B* to the leak.

The above case was chosen to illustrate one use of the dye method. In practice the dye may be used in different ways. For instance, it need not be injected at the extremity of a valved section of pipe. In a section of pipe as shown in the diagram, the dye might be forced into the main through the metered service *E* and fed towards *B* where it would be drawn off. In this case only the service pipes to the right of *E* and the gate valve *B* would be shut off. All the services to the left of *E* and gate valve *A* could be left open. The advantage of this method is that the time of waiting for dye to travel would be reduced as the distance between the points of dye injection and draw-off is reduced. It makes unnecessary the shut off of services on section (*A-E*) and reduces the length of time that service pipes on section (*E-B*) must be left closed.

Another method by which time can

be saved is to sample the water for color at the various service pipe connections as the dye progresses through the pipe. The sampling must be made at the time calculated for the dye to have reached the service. If the dye is present when the sample is drawn off it is evident that the leak is beyond the point sampled, but if clear water is drawn in an amount greater than the contents of the service pipe, then it is evident that the leak is back of this sampling point a distance equal to the volume of clear water displaced, divided by the area of the cross section of the pipe.

It is sometimes advisable to check the accuracy of the test by making a second investigation with the dye flowing in the reverse direction. If this second test does not check the first result, the presence of two or more leaks is indicated. Should there be two leaks then the dye test in the reverse direction will locate the second leak. If the pipe contains more than two leaks, those nearest the extremities of the section are located first and stopped. Then the test is repeated and the other leaks are located in a similar manner. When a section contains more than two leaks the judgment of the engineer in charge of the test is required to determine how much time is to be allowed for the dye to travel before making the draw-off. This may involve making one or two additional tests, the results of which are used to determine the location of the leaks. Obviously it is more economical to make a number of tests than to dig holes at random in a good pavement.

The dye also has been used to locate leaks on service pipes, to locate cross connections between mains and to find illegal and unrecorded service pipe connections. This method has proved to be simple, economical and accurate.

The use of the dye test is limited generally to mains 16 in. and smaller and only to those leaks that create a velocity greater than about one to three ft. per min. depending upon the size of the main. The reason for the first limitation is that in pipes larger than 16 in. the volume of clear water to be drawn off would be so large that too long a time would be required for this operation. The reason for the second limitation is likewise the element of time plus the lack of information as to the number of small leaks that cause this low velocity. These limitations are not important in Chicago because more than 90 per cent of the pipes are smaller than 16 in. and because the leaks which can be economically stopped create a velocity greater than one to three ft. per min.

Resumé of results

From 1907 to 1916 underground leakage surveys in Chicago were made intermittently but a considerable amount of leakage was stopped during that period. Since 1916, in connection with street improvements, the city has maintained a policy of reducing to a minimum underground leakage in those streets which were about to be paved. During the years 1926 to 1928, inclusive, the elimination of leakage was provided for in connection with the meterization of the southeastern section of the city; about 6,600,000 g.p.d. underground street loss was stopped during that time in 130 mi. of pipe. Between 1928 and 1932 surveys were again confined mainly to those streets which were about to be paved. Since 1932, regular yearly appropriations have been granted to carry on this work.

From January 1916 to March 1936 underground street leakage measured in Chicago in 1,957 mi. of mains tested amounted to 111.16 m.g.d. of which 102.13 m.g.d. were stopped.

From January 1932 to April 1936, 72.47 m.g.d. loss was eliminated in 796 mi. of pipe tested, an average of about 17 m.g.d. in each year since 1932. A total of 4,571 leaks were plugged each of which averaged 14,300 g.p.d. The average leakage eliminated per mi. of pipe amounted to 91,000 g.p.d.

Underground leakage and repairs in Chicago are handled by the same division, Water Pipe Extension, of which B. W. Cullen is superintendent and the writer is engineer. This division reports to Loran D. Gayton, city engineer, and through him to Oscar E. Hewitt, commissioner of public works.

Psychology in Dam Building

"BEFORE AND AFTER" at Mulholland Dam which creates a distributing reservoir on the Los Angeles water system just above Hollywood. In the picture (on the right) taken shortly after completion of the dam, note the depth of the canyon and hence the impression of height which would be paparent to one who looked up at the dam from the residential district immediately below the structure. Even after various boards of engineers had pronounced the dam safe Hollywood citizens remained apprehensive. Therefore, to meet the adverse psychological reaction, a deep earthfill was placed on the downstream side of the dam (*Engineering News-Record*, May 3, 1934, p. 558) and this was landscaped as shown in the recent picture (left) taken from near the same point as was the earlier view.

Cold Weather Experiences

A SYMPOSIUM on winter waterworks problems illustrating procedure in caring for the system during frigid weather and a variety of practical methods for maintaining service.

LONG CONTINUED periods of cold weather in January and February this year in the Middle West burdened waterworks and operators with troubles far beyond those experienced for many decades. To obtain a cross section of these problems and their solution *ENR* has gathered information from seventeen cities ranging from Duluth to Louisville and from Omaha to Detroit. Some of the experiences disclosed and conclusions drawn can be broadly summarized as follows: Electrical thawing is the most general method of dealing with frozen services and in one city a steam needle was developed. The depth of cover now in general use is about that to which frost penetrated and although this eliminates any factor of safety no one will lower mains. Impact from heavy traffic transmitted through frozen earth broke some mains and it was found that frost strikes deeper in loose sandy soils and in those having the greater moisture content. Antifreeze chemicals were used to thaw out hydrants but it was recognized that this practice might introduce a pollution hazard. One town tapped hydrants, connected a line to the sewer and left the valve open slightly.

Detailed experience in the seventeen cities reporting is as follows:

LOUISVILLE

The most prolonged cold spell in the history of the Louisville Water Co. began Jan. 23 and extended into the early part of March. With a single exception the minimum temperature every day from Jan. 17 to Feb. 23 was below freezing. Clem A. Gallagher, superintendent of services, in his report to John Chambers, chief engineer, indicates what was done, why and how. He classified troubles under four heads, emergency calls, frozen services, meters and leaks.

Calls—From Jan. 23 to March 6 there were 12,680 emergency telephone calls. Of these 3,983 were in January and 8,091 in February. Of the total calls 85 per cent were traceable to trouble inside the property line due to service breaks and freeze-ups. Front-page newspaper publicity was used to acquaint consumers with the fact that every house has a stop cock in the basement or kitchen by which the water could be turned off from the entire residence. It was appreciated that the average person is not acquainted with the shut-off valve and its manipulation. A definite educational endeavor along this line was suggested to avoid difficulties in the future.

During the emergency period all telephone lines were left open for the public and no personal calls were permitted. An emergency crew of 25 men worked in day and night shifts to render aid.

Frozen Services—Of the 73,630 installed services 1,069, or 1 in 70, was frozen. Although hot water applications was successful in several hundred of the early cases, this method of thawing was soon found inadequate and electricity was substituted. One electrical transformer was purchased and two were rented as were all the electric welding machines in the city powerful enough to supply a current of 200 to 400 amp.

A service may be frozen in three different ways; from the main to the house, from the meter to the house or from the main to the meter. Although the water company's responsibility extends only as far as the property line, service pipes inside the curb were thawed as a courtesy to the consumer without cost. To save the meter it was replaced by a nipple when current was to be transmitted from the house to the main and left out entirely when the freeze-up was on one or the other side of the meter vault to prevent a parallel path for the current through the house system. The terminal at the meter was then transferred to the outlet side, and the other terminal connected in the house to thaw the pipe from the meter vault to the house. Frozen services up to 600 ft. long were thawed out. Connections were made to the pipe at the meter vault, to the pipe in the meter vault of the house directly across the street or adjacent to the house with the frozen service. Connections at the corporation cock rather than at some distant point along the main were necessary in cases where jointing material other than lead had been used as it was not possible to carry enough current to generate the required heat. The average time for thawing a service was 20 to 30 min. depending on the length, size and extent of the freeze-up. The electrical method was successful on all sizes from ⅝ to 1 in. but useless on larger sizes.

Two types of transformers were used. In one the current was stepped down from 2,200 volts to 10 volts. This type required a connection of a primary of the transformer to the 2,200-volt service on the pole line. The other type stepped down the current from 110 volts to 10 volts; thus it was possible to hook up to the regular house service in the fuse box.

Hydrants—For thawing out fire hydrants a kerosene spray torch was purchased but the greatest success (100 cases) was achieved with ordinary automobile radiator anti-freeze placed in the hydrant. After the liquid remained in the hydrant some time it was pumped out and the hydrant flushed. Other methods, such as the use of sulphuric acid, were attempted but with less success.

Meters—From Feb. 25 to March 6, 2,964 frozen meters were brought to the shop. Many others were thawed on the job. Of the 49,680 meters in service 3 out of 50 had frost bottoms bursted. The frozen meters brought to the shop were completely overhauled and tested before returning. During the coldest period nipples replaced the meters and the vaults were packed with straw. Readings were estimated. Consumers having frozen services were advised after thawing to let a small stream run continuously but not all followed this advice and consequently some services had to be thawed as many as five times.

In January 231 leaks were repaired and in February 536. A 42-in. frost penetration in solid earth was found.

Mr. Gallagher in his conclusions indicates that electrical thawing of ordinary services is the only feasible method to use in a protracted zero or sub-zero period. Also he suggests that the entire space of the meter vault should be left free of excess earth to allow as great a volume of air in the vault as possible. In cold weather when removal of a meter is necessary a nipple rather than another meter should be inserted and readings estimated. The extra cost of the cold weather emergency work in Louisville was estimated at $10,000.

CHICAGO

Extremely low temperatures during January and February in Chicago and its effects on the water system were indicated in chart form by Loran D. Gayton, city engineer, who spoke at the recent meeting of the Illinois Section of the American Water Works Association. From Mr. Gayton's paper the following statistics are taken.

Mains 12-in. and under are laid with 5½-ft. cover; large mains have varying cover depending on the soil but 2 ft. at least is obtained. Frost penetration is generally assumed at 2½ ft. at zero temperatures and increases 1½ in. for each zero or sub-zero day thereafter. Frost

reached 5 ft. in sandy soil and 5 ft. 2 in. in clay in the south district. In the central district penetration in clay was 5½ ft. and in sand, 6 ft. In the north district the clay figure was 5 ft. and sand, 6 ft.

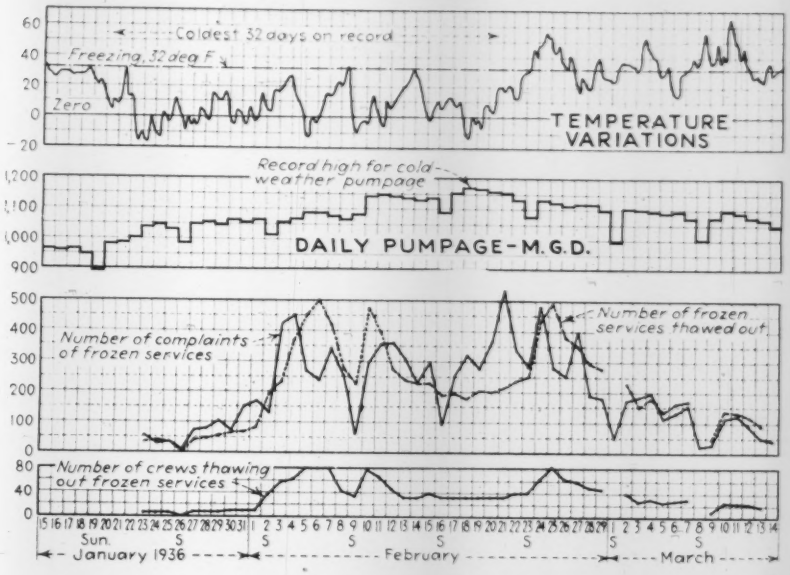
Services usually are placed 5 ft. down but in many sections where services were laid before the area was annexed to Chicago much less cover is found and from these districts came the greater number of complaints. Unheated basements also accounted for many cases. The city thawed out all services.

Fifty sections of mains 12-in. and smaller were frozen where during certain periods of the day circulation was small or absent. Many leaks indicating the location of breaks showed up after the frost came out of the ground.

Hydrant freezing was not unusual this year. A steam-thawing outfit went to each fire in the high-value area to thaw any hydrants fround frozen. It served also frozen apparatus and hose of the fire department. Some hydrant branches froze and some split. To prevent refreezing, where surface drainage would permit, hydrants were left running slightly.

Meters frozen and removed numbered 3,200 as compared with 897 in 1933, 424 in 1934 and 770 in 1935. Ordinarily meters 3-in. and over in meter vaults do not freeze but this year was an exception as the frost penetrated over 5 ft. and below the bottom of the vault so that there was no ground warmth to heat the vault.

Six types of thawing equipment were used in Chicago. For services and meters, the outfits comprised a portable gasoline-furnace-fired boiler generating steam at 10-lb. pressure and a crew of one plumber, one laborer and one truck. For use on mains where a large quantity of steam was needed two portable stream boilers on skids were provided. The pressure was 10 lb. and crew consisted of one hoisting engineer, one plumber and two laborers. Four larger outfits were used for mains and hydrants, each consisting of a truck-mounted portable steam boiler generating a large amount of steam at 20-lb. pressure. The crew consisted of one hoisting engineer, one plumber, three laborers and a driver. Where a large amount of steam at 20-lb. pressure was needed two steam rollers, attended by one hoisting engineer, one calker and two laborers were pressed into service. Twenty-one gasoline motor-driven electrical generators producing 300 amp. of d.c. at 30 volts were mounted on light trucks. Each outfit was staffed with one inspector, one plumber, two laborers and a welder. Ten two-truck transformer outfits were obtained from the Commonwealth Edison Co. Connection was made to the company's high voltage a.c. lines and the current stepped down to 110 or 55 volts; 300 to 500 amp. were delivered. The crew was an inspector and plumber from the city and a foreman, two drivers and four linemen from the company.



WINTER WEATHER conditions in Chicago and their effect on pumpage, complaints, emergency crews and services thawed

Cost of thawing 5,400 services averaged $18 each, or $101,000, including all rented equipment, labor, material and overhead. The 2,300 frozen meters involved a cost of $7,100, or $3 each. The cost of thawing mains was $6,000. Work on 4,800 frozen hydrants cost more than $14,000. To put the system back into normal condition it is estimated the total cost was $230,000. Comparative costs per service of thawing are $19.43 each by the Commonwealth Edison outfits, $12.55 by the welders and $7.20 by the steam outfits.

EVANSTON

The city of Evanston, Ill., immediately north of Chicago, taking water from Lake Michigan came through the winter with a minimum amount of trouble in comparison with many places according to W. W. Polk, superintendent and chief engineer of the water department. Only one case of intake stoppage due to frazil ice occurred. (Intake stoppage due to frazil ice is not at all rare for cities along Lake Michigan.) It disappeared after 14 hours due to a change in the direction of the wind. Lake temperature was 32.4 deg. for several weeks and although 6 in. of ice formed in the settling basins and 12 in. in a new 5-m.g. reservoir no trouble developed; there were no difficulties from ice in the two elevated storage tanks.

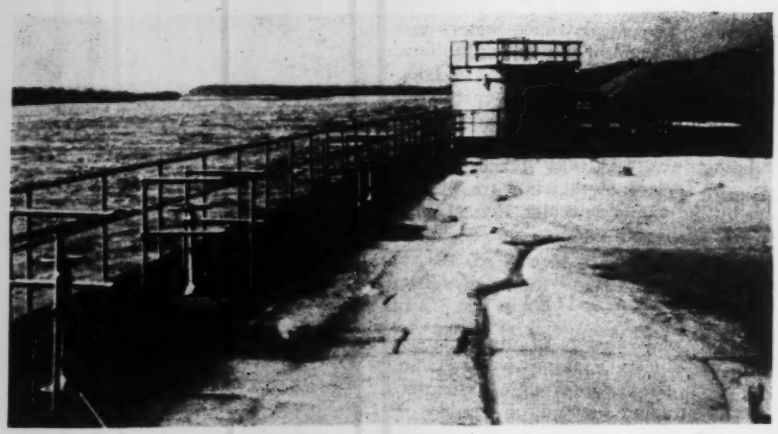
During the past 10 years there have been no frozen services or mains. Prior to this period considerable trouble was experienced and finally many services and mains were lowered. Increased circulation due to growth of the city has prevented freezing in mains having less than a 4-ft. cover. A clean transverse break in a 6-in. main under a concrete pavement with 5 ft. cover occurred this year although frost had penetrated only

SIMPLE service thawing equipment used in Chicago consists of a portable gasoline-furnace-fired steam boiler

to 4 ft. Impact from heavy traffic was blamed. One dead-end 6-in. main froze. It was thawed out electrically in 2 hr. at a cost of $20. One 4-in. main connected to a hydrant was thawed electrically in 10 min. at a cost of $10.

Seventy services with insufficient cover in a sandy section of the city were frozen. Thawing was done electrically at the expense of the owner by private contractors using welders or transformers at a cost of $10 to $15 per service. The water department does not own electrical thawing equipment. Six-inch mains are laid with 5-ft. cover but less for larger pipes. This year's experience, Mr. Polk states, does not indicate deeper trenches are desirable. Frost penetrated 5 to

A STEAM BOILER on a truck, producing plenty of 20-lb. steam is required to thaw out mains and hydrants—Chicago has four outfits like this



SEDIMENTATION BASINS at Alton, Ill., in February. A frozen pipe put one of the units out of commission thus severely curtailing plant settling efficiency when turbidity in the river supply (left) was high

5½ ft., in sand and gravel, and under pavements and sidewalks it penetrated 6 ft. in sandy soil.

Circulation as a preventative of freezing was exemplified in the case of two uninsulated bridge crossings. Both pipes are of steel, 12 and 16 in. in diameter respectively and at no time did they become frozen.

OTHER ILLINOIS TOWNS

From C. W. Klassen, acting state sanitary engineer of Illinois, is contributed the following notes on some of the downstate plants:

At Chester the intake pipe into the Mississippi River was torn away by floating ice resulting in a change of raw water quality in addition to physical and mechanical difficulties. Exceptional high chlorine dosage was demanded. The operator, who is also the superintendent, was so busy thawing out services he could not carry on his routine laboratory control. Some insufficiently chlorinated water got by but no ill effects resulted. State Board of Health engineers rendered aid at this crucial time. The lesson is that sufficient operating personnel should be provided at all times.

At Alton, also on the Mississippi River, a cast-iron pipe between two sedimentation basins was frozen and broken putting one basin out of service thus curtailing the settling period. Turbidity in the filtered water was increased due to this conditions and to high consumption crowding the filters.

The operator at Pittsfield had trouble keeping his chlorinator warm and at night wrapped it in his sheepskin coat. Further ingenuity was exhibited by the Pittsfield superintendent in handling frozen meters. He dropped a lighted piece of burlap saturated with crude oil and fastened to a wire into the meter box. When gas formed and the meter started to go out he jerked on the wire until the burlap again started to blaze. Next year he proposes to pack the meter boxes with leaves or straw.

At the Decatur softening plant a 4-in. gas main which delivered CO_2 for recarbonization purposes froze. The main was disconnected at the recarbonization chamber and plugged. Some 200 lb. of calcium chloride was dissolved in 50 gal. of water and the solution introduced into the main at the plant where the gas left the compressor.

The main is 400 ft. long and had 14-in. cover. The solution remained in the pipe for 2 hours after which it was blown out by starting the compressor. The cost was $3.36.

At Kankakee at the softener plant ice formed on the clarifier and had to be removed frequently. A large pile of ice accumulated around the plant but this was hauled away by a local ice dealer for domestic refrigeration.

Some 200 cases (probably the figure is far in excess of the actual number) of mild dysentery were reported in Kankakee but were not definitely traced or attributed to the water supply by the state board officials.

During the excessively cold period high consumption due to open taps overtaxed the purification plant and softening was discontinued. Consumption jumped from 2 to 4 m.g.d.; the capacity is 4 m.g.d. The plant has excellent laboratory control. Change in mineral content was not considered of sufficient magnitude to have a physiological effect but might possibly cause certain disturbances.

At Jacksonville the turbidity rose in a large reservoir from 25 to 2,100 p.p.m. and in one month's time the settling basins accumulated as much sediment as in a normal 4-months period.

Springfield, pending completion of a new purification plant at Lake Springfield, takes water from infiltration galleries along the Sangamon River; hardness dropped from a normal of 250 to 80 p.p.m., a figure to which the water is normally softened. This was considered part compensation for the expense involved in thawing many frozen services.

East St. Louis water company officials estimated cold weather extra costs at $25,000 for rent of additional thawing equipment, free water furnished customers while services were being thawed and loss of revenue because of the great number of frozen services which could not be used.

Private wells in large numbers throughout Illinois were pressed into service during the extreme weather many of which undoubtedly were not safe thus creating an indirect health hazard.

OMAHA

Between 2,000 and 2,500 services were frozen and thawed by contractors in Omaha, Neb., from Jan. 1 to March 10, compared with 10 to 15 services in a mild winter as reported by J. C. Detweiler, construction engineer, to T. A. Leisen, general manager, Metropolitan Utilities District.

A majority of the frozen water services in Omaha were thawed by means of electric current, although there was one plumber who used a device called a "steam needle." This is a very small copper tube supplied with steam from a portable steam boiler operating under 100-lb. pressure.

Water and gas mains have been laid with a cover of 4½ ft. which has apparently been sufficient cover to prevent freezing under most conditions. It is questionable Mr. Detweiler says, whether it would be advisable to change the method of main installation to produce a greater cover since these severe winter conditions may not occur for another 50 years.

The depth of frost was quite consistently the same under paving, that is, the penetration varied only from about 3½ to 4½ ft. The four breaks experienced in water mains were not serious but repairs were delayed by the deep frost. A chlorine residual was maintained in the regular distribution system through the winter periods without any difficulty. In addition to the four frozen mains, of which three were on dead ends, nine breaks occurred in mains and three in hydrant branches.

MUSCATINE

William Molis, superintendent of waterworks, Muscatine, Ia., one of the oldest living members of the American Water Works Association, states that he had 150 frozen services, lays pipes in 5½ to 6-ft. trenches, finds some diference in frost penetration but not much in the various soils in Muscatine. He had no broken mains during the past winter.

CEDAR RAPIDS

Where the snow was removed in streets and over sidewalks a large number of services (500 out of a total of 13,000) in Cedar Rapids, Ia., were frozen, according to H. F. Blomquist, superintendent of the city waterworks. Some of the services froze two and three times. The average heretofore has been less than a dozen a year. Thawing of services was carried on by local electric welding contractors at the owners' expense.

Mains and services are laid under at least 5½ ft. cover. Where the snow, which came early and was left undisturbed the frost was not deep. This winter's experience indicates that 5½-ft. depth of cover should be increased under the streets and sidewalks. For two weeks the average temperature was 14.5 deg. below zero, a record not exceeded before in 117 years of records.

Only two short dead-end mains (only one customer on each one) and four fire hydrants were frozen. This record is attributed to the extreme care in maintaining hydrants and preparing them for the winter season by making certain that they drain after being used.

A 50,000-gal. elevated tank with a 12-in. riser pipe, insulated with three dead air spaces, came through the winter without being frozen. No attempt was made to increase circulation in the distribution system by closing valves but in a few instances mains in outlying sections were flushed. Only three breaks of mains were attributed to frost.

YANKTON

A. C. Ellerman, commissioner of water, Yankton, So. Dak., reported many more freeze-ups than usual due to a period colder for a longer time than any of record. Frost penetration was 4 to 5 ft.; more on low, flat ground and less at higher elevations, a condition attributed to variation in moisture content.

Seventy-five of 1,400 services gave trouble. With 6-ft. coverage no feezing occurred but improvement work which changed grades left some of the lines with only 3-ft. cover. Some of these shallow mains over which pavement had been laid were insulated at the corporation cock at the main and the service lines dropped to give 5-ft. coverage. None of these services so treated gave trouble. A new ordinance calls for 5-ft. cover over services and insulation where it passes through the basement wall so that the frost will not be conducted to the pipe.

Outlying hydrants are being supplied with ¾-in. taps connected with the sewers and the line bled to keep up circulation.

Artesian well water, a former supply, was pumped into the mains for a week to replace the treated Missouri River water registering 31 deg. but the higher temperature of the well water did not help. In fact, Mr. Ellerman states, a greater number of services froze after pumping in the artesian supply.

An elevated tank acquired a heavy layer of ice but caused no trouble, a larger pumping unit being used to insure a continual variation in the elevation of the water surface in the tank.

DULUTH

With the coldest winter of record Duluth, Minn., had 281 frozen services, more than 600 frozen meters and 11 frozen mains, states Felix Seligman, manager of the water and light department. Normally few if any services freeze, as they are laid to a 7-ft. depth wherever possible. In some places this depth is not feasible. The average normal frost penetration is 5½ ft. but this year it was 7 ft.

Thawing equipment used by the department consists of portable electric generators and one 20-kw. transformer.

No mains froze where the water circulated; trouble with dead-end mains was avoided by bleeding. No trouble has been experienced with elevated tanks or standpipes; where consumption is light tanks are removed from service and drained.

Breaks in mains and services were found to occur where the service enters the dwelling or at the curb cock due, it is felt, to unequal movement of the earth at these points. The area under a dwelling is relatively free from frost, while the adjacent area is subject to frost and consequent heaving. The same condition exists at the curb cock after the snow insulation has been removed from the street.

DETROIT

This winter 1,125 services in Detroit, Mich., froze as compared with 150 in 1934 and none in 1935, a mild winter. In one day this year 165 frozen services were reported by W. C. Rudd, assistant engineer of the power and water department, a greater number than for the whole 1934 winter. Pipe lines in graded streets were laid with 5-ft. cover and in ungraded streets another foot is added. No change in this practice is contemplated. Maximum frost penetration was 5 to 5½ ft. where usually it has been only 3 to 4 ft.

Elevated storage tanks whose contents were not continually changing in level, were drained and removed from service early in the season.

Seven breaks occurred in mains over 12 in. in diameter and many in small 6 and 8-in. lines. No pollution danger exists, Mr. Rudd feels, as there was very little indication of drainage into the breaks. After a break large mains were chlorinated before they were put back into service.

Iron and Manganese Removal at Lincoln

An iron and manganese removal plant put in operation at Lincoln, Nebr., in December, 1935, has greatly improved the quality of the well supply. D. L. Erickson, City Engineer, reports that the process used consists of aeration, chlorination, upward flow through gravel contact beds, two-hour sedimentation and final sand filtration.

The iron content in the raw water supplied by seven wells varies from 0.4 to 0.8 p.p.m. and the manganese content from 0.5 to 1.0 p.p.m. depending upon the particular wells being pumped.

After five months' operation, the plant is producing an effluent containing less than 0.10 p.p.m. of iron and approximately 0.27 p.p.m. of manganese with the use of 1.5 p.p.m. of chlorine. The manganese removal is showing constant improvement with increasing deposition of manganese coating on the sand grains in the final filters, and it is confidently expected that at the end of one year's operation the manganese residual will not exceed 0.1 p.p.m.

Crenothrix Chokes Conduits

IRON BACTERIA in sections of Hetch Hetchy supply system thrive on highly mineralized water and resulting slime growth reduced pipe capacity 16 per cent—Chlorine and ammonia treatment most effective method of control

G. E. ARNOLD
Water Purification Engineer, San Francisco Water Dept.

A SEVERE attack of *Crenothrix*, the first to be experienced in the San Francisco water supply system, developed last year and since then has been under constant observation and treatment. The growth of these iron bacteria had become quite serious before its nature and extent was fully realized, but analyses of highly mineralized water which was known to be seeping into the Coast Range tunnels were on file and the risks entailed were appreciated. Various methods of treatment have been tried experimentally but only the chlorine-ammonia treatment thus far has been found to be effective. Plans are under way for using this treatment on an extensive scale at the east end of the tunnel in which the mineralized water comes in. The history of the case and the measures taken to date are outlined in the following.

In the 150 miles traversed by the mountain water supply that comes to the San Francisco peninsula from O'Shaughnessy Dam in the high Sierra, only the latter part of the route is of interest in connection with the Crenothrix problem. In the accompanying schematic sketch is shown the relationship of the physical features of the system west of the San Joaquin Valley. Up to the point where the water enters the eastern end of the Coast Range tunnels (Tesla portal) there have been no difficulties in keeping the conduit free from growths and maintaining the high degree of purity natural to a mountain source. The difficulty experienced thus far has been traced definitely to the Coast Range tunnels.

These tunnels, totaling 29 mi. in length, were by far the most difficult portion of the aqueduct to build. Extremely heavy ground was encountered in the driving and with it an inflow of ground water that ranged up to 3.5 m.g.d. Attempts were made to grout the tunnel lining to seal off this inflow but despite the greatest care, about 1.5 m.g.d. was still inflowing into the tunnels when grouting was finished and the line was ready for service. This ground water, which has continued to seep into the aqueduct and thus is mixed with Hetch Hetchy water from this point on, is highly mineralized. A typical analysis with contents in parts per million compared with Hetch Hetchy water is given in the following table:

	Ground Seepage	Hetch Hetchy Water
Total solids	1060	13
Volatile matter	220	1
Silica	20	1.7
Sodium	129	3.5
Calcium	115	1.2
Magnesium	37	0.26
Iron	1.3	0.04
Aluminum	0.6	0.01
Bicarbonate	380	8.5
Sulphate	350	.58
Chloride	32	3

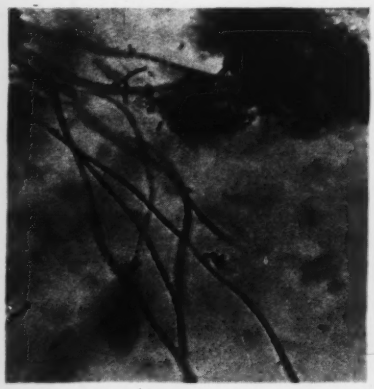
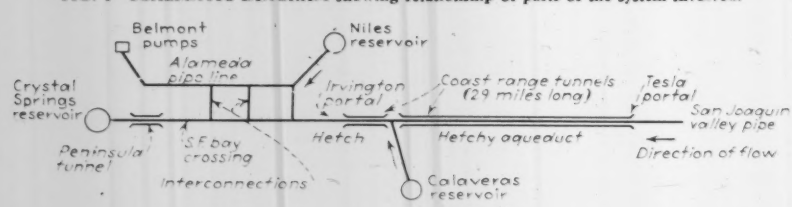


FIG. 2 — CRENOTHRIX ORGANISMS from Hetch Hetchy tunnels—a 400x microphotograph.

FIG. 1—SCHEMATIC DIAGRAM showing relationship of parts of the system involved.



These tunnels are of a size calculated to take half the ultimate capacity of the Hetch Hetchy conduit, that is, the tunnel of 10½-ft. dia. now in service, with a capacity of 200 m.g.d., is to be paralleled by a twin bore at some future date. For the time being the flow through the tunnels is limited to the capacity of the 47-mi. steel pipe line across the San Joaquin Valley immediately east of the Coast Range tunnels. The first unit in the series of steel pipes that will be laid in San Joaquin Valley as more capacity is needed, was put in service in October, 1934, carrying a flow of 45 m.g.d. After February an additional 10 m.g.d. was passed through the aqueduct. At Irvington portal, the west end of the Coast Range tunnels, flow continues in the new Hetch Hetchy line across San Francisco Bay but part of it may be diverted into the Alameda line of the old Spring Valley Water Co. which also crosses San Francisco Bay and goes to the Belmont pumping station. The Alameda line consists largely of 36-in. wrought iron pipe. It is 22 mi. long and was laid in 1887. Under normal conditions of operation it carries 16 m.g.d. from Niles reservoir to Belmont. Recently it has been receiving water from the Coast Range tunnels which has been brought in through a number of bypasses.

Trouble in the line

About three weeks after Hetch Hetchy water was turned into the Alameda line, carrying capacity started to drop off at the rate of 0.2 m.g.d. Within three weeks the flow decreased from 16.2 to 13.6 m.g.d., a capacity loss of 16 per cent. Tests failed to indicate any air pockets or other obstructions along the line and on March 27, 1935, the line was opened for inspection. A slimy, gelatinous growth was found, light brown in color, covering the entire inner surface of the pipe from ⅛ to ¼ in. thick.

Microscopic examination showed this growth to contain the iron bacteria *Schizomycetes Crenothrix;* inspection of the Hetch Hetchy Bay crossing disclosed a slight growth of the same organisms and subsequent examinations showed this growth increasing to a density greater than that in the Alameda line.

Numerous inspections of nearby lines showed that the slime growth originated in the Coast Range tunnels and was continuous throughout almost their entire length. Heavy growths of *Crenothrix* were found at points where seepage was entering the tunnels. Samples of seepage water contained almost pure cultures of the organisms and dow-

stream from points of seepage entry the walls were almost completely covered with heavy growth which seeded the entire flow through the tunnel and subsequently developed growths farther along in the system.

The slime growth was found to be much heavier below the point at which water from Calaveras reservoir was put into the Hetch Hetchy aqueduct. This was ascribed to the higher mineral and organic content of the Calaveras water which probably supplied food for the bacteria. Chemical analysis of the slime growth indicated the following:

Volatile matter	48%
Calcium	26 "
Magnesium	3.2 "
Iron	1.4 "
Aluminum	3.9 "
Sulphate	4.9 "
Silica	12.5 "

In addition to the decreased carrying capacity, whenever a portion of the line was shut down the water left standing in the conduit developed an objectionable taste of a strong medicinal or woody nature. This was ascribed to the increased contact time between water and the growth. Half of the dissolved oxygen content of the water is lost in its flow through the Coast Range tunnels.

Various means of controlling the *Crenothrix* growth have been tried in the laboratory and in the field. Copper sulphate, lime, chlorine and ammonia have been applied in different ways. Ultimately of course, the major control treatment must be applied at the source of the trouble in the Coast Range tunnels. Meantime, for experimental purposes, quicker results and more definite indications are possible in readily accessible points including an experimental plant where different treatments are applied to water in eight 4-in. pipes each 300 ft. long. This plant has been in operation for six months and Hetch Hetchy or Calaveras water is passed at low velocity through these several lines which are arranged in parallel.

A chlorine dose of one p.p.m. applied at Irvington was fairly effective in killing the growth in the Bay crossing as far as the chlorine residual could be carried, but was ineffective beyond that point. This treatment, however, produced a chlorinous taste in the water.

The use of some chemicals was entirely unsuccessful in killing or reducing the growth. Copper sulphate was applied continuously to one of the submarine pipes of the Alameda line using a dose of about 2 lb. per m.g. This was apparently ineffective. Hydrated lime was added to the water filling one section of the Coast Range tunnel in a sufficient quantity to raise the *pH* of the water to 10. This water was held in the tunnel for four days in contact with the slime but produced no beneficial results. In several months of treatment in the experimental plant mentioned in the foregoing, varying amounts of copper sulphate and lime did not produce beneficial results.

However, on June 17, 1935, application of chlorine and ammonia was started at Irvington using 1½ lb. of ammonia and 6 lb. of chlorine per m.g. Within a week there was a noticeable decrease in the growth for the entire length of the Bay crossing line. The chlorine-ammonia treatment did not produce a taste in the water and over a period of several months conditions have steadily improved until at the present time there is no indication of growth anywhere in lines carrying water treated in this way. Meantime, the untreated growth in the tunnel has continued undiminished.

Treatment of the long tunnel where the *Crenothrix* gets its start has not yet begun but construction of a chlorinating station at Tesla portal on the east end of the Coast Range is planned for the near future. In addition to the plant at the portal, other stations along the tunnel may be necessary as it may not be possible to effectively treat the entire 29-mi. tunnel from one point.

A Load Factor Water Rate

SLIDING SCALE applied to large consumers based on elements used in electrical distribution rate-making

W. A. KUNIGK
Superintendent, Water Division, Tacoma, Wash.

PULP MILLS, like certain large industries, have a fairly uniform demand for large quantities of water that must be available at a low rate. Any desire there may be to encourage such industries by attractive rates is restrained by the fact that water utilities are prohibited by law from furnishing water below cost. Into the situation presented by these two considerations comes the fact that a large percentage of the cost of delivering water is directly chargeable to the expenditures made for distribution mains. In other words, a service that does not entail the cost of maintaining an expensive network of pipes can be furnished at a correspondingly lower cost.

When the question of water rates to pulp mills at Tacoma arose, a study was made of customary practice in the somewhat parallel case of distribution facilities for electrical energy. In that field the common basis of payment is load factor, or demand factor. The lowest rates are quoted when the peak demand comes nearest to the average load. It appeared that the elements which suggest this basis of rate making in the electrical field are equally applicable in working out equitable water rates for large consumers.

Based on this theory the city of Tacoma is establishing a low industrial water rate for consumers who use not less than 1 m.g.d. or, say, 4,000,000 cu.ft. per month. A uniform rate of consumption that would use this much water would be 1.543 sec.-ft. That is, constant use at exactly this average rate would represent a 100 per cent load factor for this monthly quantity.

The new load factor rate is based on the monthly maximum demand in cubic feet per second, which is taken as the average rate of consumption in four 30-min. periods of peak demand. The demand for each 30-min. peak period is taken as the average rate of consumption for that period, and the four peak periods which determine the monthly maximum demand are taken at intervals at least 3 hr. apart as shown by the recording chart. For this class of service venturi meters are used and the quantities of flow are shown on recording charts and totalizers.

The monthly water bills are to be determined from the meter readings in cubic feet. The charge per cubic foot will begin at 1½ cents and range downward to ½ cent according to the following scale:

1—SLIDING SCALE WATER RATE FOR PULP MILLS

	Rate per 100 Cu.Ft.
First 1,000,000 cu.ft. for each sec.-ft. of monthly maximum demand	1½c.
Next 1,000,000 cu.ft. for each sec.ft. of monthly maximum demand	1c.
Next 592,000 cu.ft. for each sec.-ft. of monthly maximum demand	½c.

As 1 sec.ft. of demand is equal to 2,590,000 cu.ft. per month, the monthly bill for a minimum consumption of 1 m.g.d. (approximately 4,000,000 cu.ft. per month) will be $431.45, or $14.38 per million gallons, which is 1.08c. per hundred cubic feet.

Serving Ships With Water

DOCK facilities at San Francisco include special distribution equipment and personnel to provide metered water to steamers berthed along the waterfront

METHODS used in supplying fresh water to vessels berthed at San Francisco piers have developed from experience during the gradual growth of the port rather than as the result of any preconceived plan. With a minimum of equipment and a very small crew, operating costs are quite low for this highly important service maintained on the miles of berthing space managed by the California State Harbor Commission.

Maintenance of the water pipe systems on the piers is handled in two ways: (1) by the Harbor Commission on those piers where the piping is owned by that organization and (2) by the city's Water Department on piers served by the Department's own pipes. This split arises from the fact that long ago the Spring Valley Water Co. (predecessor of the Department) installed piping on new piers as they were built, treating the pier area much as a new land subdivision. More recently all piers have been constructed and used as structures in the same sense as office buildings; the Department felt that it should not install nor maintain pipes within "structures" and has limited its responsibility to water metered into the customer's pipes at the property line. This difference in policy affecting the old and the new piers extends only to the ownership and maintenance of the piping; Water Department crews take meters to any point along the waterfront and serve shipping wherever service is requested.

In general piers are classified as "open" and "closed." Open piers are those on which there are no permanently installed meters and water service is supplied only on application. Closed piers are those leased to companies which pay for water service through permanently installed meters just as would any other industrial enterprise at the regular meter rate. On request the Water Department will send its crew to a "closed" dock, meter water to a vessel berthed there, make the usual retail charge to the vessel and then credit the company leasing the pier with a quantity of water equal to that sold.

Management of Water Department activities on the waterfront is in charge of a supervisor of pier and ship service. Other full time employees are two hosemen who handle the equipment used in delivering metered water to steamers, two maintenance men and a part-time bookkeeper. The only other regular attention to waterfront service is reading the permanently installed meters; this is done by the regular meter reading staff.

Equipment includes, primarily, a supply of meters, mostly of 1½- and 2-in. size; a quantity of 1½- and 2-in. rubber and canvas hose and a 1-ton Ford truck used primarily by the hosemen and at times by the maintenance crew, respectively. Their headquarters is a stock room and repair ship on a centrally located pier. The meters used are from the Department's standard meter stock and are adapted for waterfront service by the simple addition of a 4-ft. length of rubber hose (called a "spud"). This is for convenience in connecting to the hydrant which is frequently below floor level. Thus no special portable meter equipment is required for the waterfront; meters used there are at any time interchangeable with others.

Procedure and rates

When a request is telephoned for water service to a ship, the hosemen drive onto the pier with meters and hose, unlock the most convenient hydrant, connect meter and hose lines and read the meter before turning on the hydrant. If a considerable quantity of water is required the hosemen may move to another job, leaving it to the crew of the vessel to turn off the hydrant when the desired quantity has been delivered.

Hose are kept rolled in 50-ft. lengths. Usually three lengths are ample for reaching from pier hydrant to a steamer's tanks; rarely as much as 300 ft. will be required. Hose is never put aboard ships of American registery; they are required by law to carry their own hose and they have standard couplings. In foreign ships, on the contrary, the Water Department hose is practically always taken on board to deliver directly into the ship's tanks. A primary reason for this is that metric system couplings are usual on foreign ships.

The rates for water metered to ships, including the connections specially made by the hose truck crew, are as follows:

For the first 1,300 cu.ft. $1.08 per hundred cu.ft.

For the next 2,000 cu.ft. $0.259 per hundred cu.ft.

For the next 3,000 cu.ft. $0.227 per hundred cu.ft.

For all over 3,300 cu.ft. $0.194 per hundred cu.ft.

The minimum charge for each delivery trip or monthly use is $.70. Except for the first item, the rates in this table are the same as those for domestic and industrial services generally, after the monthly service charge is made. In other words, the service charge is paid by ships in the rate on the first 1,300 cu.ft.

Distribution piping

On the older piers the water supply lines are 4-in. pipes from which 2-in. hydrant services are taken off at regular intervals ranging up to a maximum spacing of about 150 ft. Usually the mains are hung under the piers by strap hangers clamped to the concrete. In some cases the mains were laid in the corner of a depression provided for depressed railroad tracks. In such cases the laterals were passed through holes in the floor and hung under the piers in the usual manner. Maintenance on pipes beneath the piers is done by the two maintenance men from a scow which carries the necessary tools, lead pot, etc. Mains and services of the sizes mentioned are sufficient to handle about 90 per cent of the ships that apply; for the remaining 10 per cent extra lines (with a meter on each) from the nearest hydrants are brought in to speed delivery.

In later years most of the lines built by the State Harbor Commission have been 6 in. in diameter as this size is insisted upon by the companies operating the larger steam ships. In these more modern installations the custom is to put in a closed line. That is, the lines along each side of a pier are connected across the outer end. With a valve in this cross-connection and a valve at the shore end of each line it is possible to shut off either side for repair.

Originally 1½-in. hose was the standard size. As larger ships were built there was demand for more speedy delivery. A supply of 2-in. standard canvas fire hose was purchased and with this two or sometimes three hydrants are tapped to increase rate of delivery. The heaviest demand is from the large round-the-world liners, in port for very short stays and requiring large quantities of water. The Empress of Britain, in port usually less than two days, sometimes takes as much as 90,000 cu.ft. When shipping business is good the hose wagon crew sometimes serves 150 ships per month. Billings for this service always go to the ships' local agents. Cash sales are limited almost exclusively to foreign naval vessels.

Long Flume Service

HIGH maintenance costs and heavy leakage cause abandonment of a California structure that had given service for 65 years. Replacement made with standard metal flume

B. H. SKILLINGS
Assistant Engineer,
San Jose Water Works.

REPLACEMENT of a wooden flume by a metal flume in the San Jose, Calif., water supply system, recently concluded the "all timber" chapter in the history of a structure that had given service for about two-thirds of a century. Several years ago, at a time when the flume was carrying about half capacity, gagings were made at intake and delivery ends of the flume and these showed that 13 per cent of the water entering the flume was lost by leakage. At the same time it was noted that in the preceding 10 years maintenance costs had averaged about $3,700 per year, the major portion of which was on the flume box itself. The decision then was reached to replace the old structure with a metal flume, thus avoiding both leakage and the necessity for constant repair.

The flume was constructed in 1870 to bring water from Los Gatos Creek for hydraulic power at a flour mill. The water it carried was pure and desirable for domestic purposes, and after it had been used for power development at the mill it was taken over by the San Jose Water Co. under an agreement with the mill owners. About 1900, when the mill no longer had need for the flume, the water company assumed its exclusive use and maintenance.

From early records it appears that in 1888 considerable work was done on the flume amounting practically to reconstruction. Since then portions have been renewed from time to time until all parts of the flume, it is believed, have been replaced at least once subsequent to the 1888 reconstruction. The flume box was 28 in. wide and 26 in. deep and was built of 1-in. redwood boards, for the most part 14 in. wide. In its 3 mi. length it followed an extremely sinuous route partly along precipitous slopes.

It was desirable to have the new conduit capable of delivering about 10 m.g.d. and it was found this requirement could be met by using a standard metal flume, 45.84 in. in diameter. In several short sections of the original flume 29-in. pipe had been used and it was decided to replace these with 33-in. concrete pipe, in which the hydraulic gradient would be 0.0006 as against the 0.00825 gradient of the flume sections. Using a value of 0.013 for the coefficient n in Kutter's formula, the capacity to be expected in the flume selected worked out as 14.8 sec.-ft. The total fall in the 16,601-ft. length is 13.63 ft.

The estimated cost of the new flume was $102,500. It was planned to undertake construction with the water company's own forces and to keep annual expenditures within the funds available annually. Accordingly, the work was divided into three parts to be carried out in 1933, 1934 and 1935, respectively and this program has now been successfully completed.

The route taken by the old flume was of considerable aid in making a survey to determine the exact locations of the new flume and also aided in placing materials. Timber for the new substructure as well as the metal flume sections were delivered by motor trucks to convenient points along the line and thence were moved along the top of the old flume by hand with the aid of dollies made with automobile wheels.

As soon as all material distributed in this way was in place, water was shut off, the old structure was demolished and erection of the metal flume begun. Timbers that were not interchangeable

FIG. 1—THE OLD FLUME after 65 years of service was leaky and costly to maintain.

FIG. 2—PRECIPITOUS SLOPES are traversed by the flume which has a total curvature of 4,566 deg.

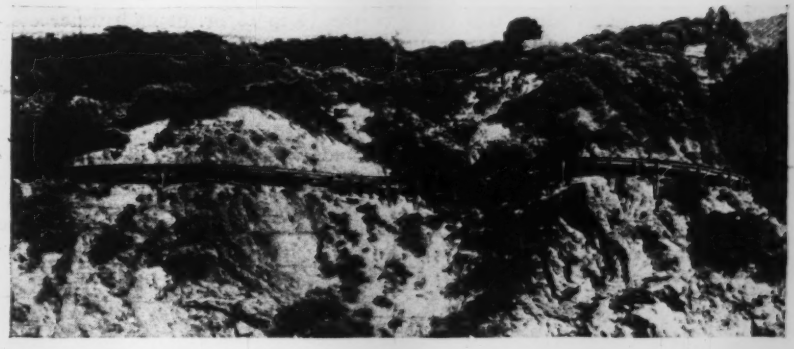


FIG. 3—A BOARD COVER for the entire length of metal flume keeps out rocks, twigs and leaves.

were marked with bent numbers indicating their location and were delivered alongside stakes marked with corresponding numbers. This method worked satisfactorily and permitted construction to proceed simultaneously at several points.

In view of the long life expected, a creosoted timber substructure was justified. All framing and boring of the timber was done at the mill before treatment. No framing had to be done in the field. A total of 215,000 ft. b.m. was used in the substructure. Galvanized hardware only was used in assembly. For the entire length the flume was covered with transverse boards held in place by longitudinal cleats that rested on the girders of the flume substructure. The cover is made into removable panels each about 4 ft. long. Douglas fir was used for substructure erected in 1933 and 1934; for the 1935 work redwood was used because the price was then somewhat lower and the prospect for prompt delivery was decidedly better—the redwood could be delivered from the mill to the job by truck. During the first year of the work only concrete footings were employed. Thereafter wood sills were used as the additional cost of the concrete was not considered justifiable.

The sinuous nature of the location is shown by the fact that the total curvature in 16,601 ft. is 4,566 deg. Where the location follows precipitous hillsides there is some danger of rock slides and at a number of these places timber sheds were built over the new flume.

Despite this precaution a 200-ft. length of the flume was carried out in January, 1935, by a large slide following an unusually heavy rain. Investigation of the possibility of preventing such slides resulted in the decision that since a recurrence was rather unlikely it would be more economical to reconstruct each break than attempt to provide costly protective structures.

The new line was put in service late in 1935. Early in 1936 a full capacity test was made on the entire length of new flume. Two velocity type meters of 8- and 24-in. diameter respectively, each equipped with a totalizer and rate of flow indicator, were used to measure the flow at the discharge end of the flume. These measurements showed a delivery of between 9.5 and 10 m.g.d., confirming the calculations made when the structure was planned.

J. W. Ford is chief engineer of the San Jose Water Works. The writer, as assistant engineer, had charge of flume reconstruction.

Handling Peaks at Sacramento

COMBINED concrete and steel elevated tanks for balance service and additional wood-roof clearwater reservoir form the major features of current program for improving distribution

MORE efficient operation of the water system serving Sacramento, Calif., is to be accomplished by four projects which that city now has under way. The largest item is the construction of two 3,000,000-gal. storage tanks worthy of note as unusual in size and also in design, which contemplates the use of steel plate sides encased in concrete. Supplementing these are two new pumps of 10 and 25 m.g.d. respectively, a covered reservoir for filtered water and some 2½ mi. of large mains.

Need for the large elevated tanks arises from the fact that Sacramento's filtration and pumping plant is located in the extreme northwest corner of the city and water is delivered throughout the distribution system without any boosting along the line. Considerable drops in pressure have been inevitable in times of heavy loads, notably in the outlying districts during the peak demands of summer. The use of tanks as balancing reservoirs will also effect a considerable saving in power charges by flattening the peaks of pumping loads.

Peak load provided for

Heretofore any interruption in the pumping service has paralyzed the system. The new tanks will provide a standby storage at peak load for about 2 hr. The tanks will be filled during the off-peak night hours and will be drained automatically during the day at a rate to insure a balance of pressure in the 14 to 15 hr. of high water consumption.

The tanks are to be 146 ft. in diameter and 105 ft. in total height. The water depth will be 25 ft. and the floors will be elevated about 75 ft. above the ground, thus giving a head of about 100 ft. net above ground level when the tank is full. Foundations are spread footings carrying a reinforced-concrete circular wall and interior columns supporting a flat reinforced-concrete floor. The superstructure in each case will consist of a tank with sides of steel plate surrounded by a reinforced concrete wall. The roof will be of redwood covered with asbestos felt. Concrete columns within the tanks carry the roof. The contract price for the two tanks is $315,347.

Sacramento's average water consumption throughout the year is about 23 m.g.d In summer, however, the total daily consumptions reach peaks of 37 m.g. Thus the existing 5-m.g. reservoir for filtered water, which is all the filtered storage the city has had thus far, gives but little balance between the city's demand and the product of the filters and pre-treatment works. The present project of an additional 8-m.g. filtered water reservoir will provide a highly desirable balancing effect at the pumping plant and also make it possible to dewater one basin while the other is in service.

The new basin will be 275x315 ft. in plan with vertical walls 19 ft. high. Floor and walls will be of reinforced concrete; interior concrete columns will support a wooden framework for the roof of creosoted Douglas fir covered with asbestos felt. Three baffle walls built of shotcrete, are provided in the basin to prevent short circuiting of the water.

New pumping equipment which will augment the present installation above the requirements of the Board of Fire Underwriters for standby equipment is to include one 25-m.g.d low-lift pump and one 10-m.g.d. high-lift pump at the pumping station of the filter plant.

To make the new elevated tanks effective about 13,000 ft. of 24-in. welded steel force main ¼ in. thick are being added to the system; this will provide desirable connections with existing mains remote from the tank location. Also 12-in. cast-iron mains are being relocated and supplementary 16-in. cast-iron mains are being added for interconnections.

Personnel

James S. Dean is city manager, Fred J. Klaus is city engineer and R. E. Mittelstadt is superintendent of the water division of which Carl M. Hoskinson is chief engineer. Henry D. Dewell, of San Francisco, is consulting structural engineer on the elevated tanks and on the reservoir. On the latter bids were called in April.

Artificial Groundwater

SHALLOW basins covering 183 acres of gravel area are periodically spread with surplus water to replenish groundwater furnishing part of the Los Angeles supply

D. A. LANE
Assistant Engineer, Los Angeles Bureau of Water Works & Supply

AT THE TUJUNGA spreading grounds, a gravel area in the San Fernando Valley, artificial replenishment of groundwater storage basins safeguards a source that provides about 30 per cent of the Los Angeles domestic water supply. Five years of successful experiment with these spreading grounds is outlined below. The grounds have an area of 183 acres, of which the 47-acre portion now in use represents a capacity of 106 sec.-ft. This is adequate capacity for present conditions because this quantity of flow is as much as can be drawn from the Owens River aqueduct without interfering with service to areas lower down. The spreading is done mainly in winter. The maximum quantity of water available for spreading never has equaled the capacity of the spreading grounds, which is calculated to be 30,000 acre-ft. per season. Spreading at this plant was started in 1931 and in the five seasons during which it has been operating a total of 110,000 acre-ft. has passed through it into the underground storage basin below.

Method of operation

The area is divided up into basins averaging 100x400 ft. in size, varied somewhat to conform to the plant's layout. The average height of the checks or dikes between basins is 4 ft., and their base width is 15 ft., a size determined mainly by the quantity of silt and soil which had to be removed from the basin floor to expose the best materials for spreading. The flow into each basin is through a 6-in. pipe, whose valve is adjusted to maintain an average water depth of 6 in. in each basin. Greater depth has been found to permit the formation of waves which endanger the side walls. There is no overflow, and no interconnection between basins.

Before water is turned in, the bottom of the basin is cultivated with a spring-tooth harrow drawn by a small tractor. The small ridges thrown up by this operation are kept open by wave action and silt settles in the small valleys. Immediately after harrowing the rates of percolation may be as high as 10 ft. or more per day, but this rate decreases to about 3 ft. per day if operation of the basin is continued without interruption for long periods. Harrowing the basin at about 10-day intervals gives the best results consistent with economical operation. The time required for drying out and harrowing a basin varies from 8 to 24 hours, depending upon weather and the resultant rate of drying.

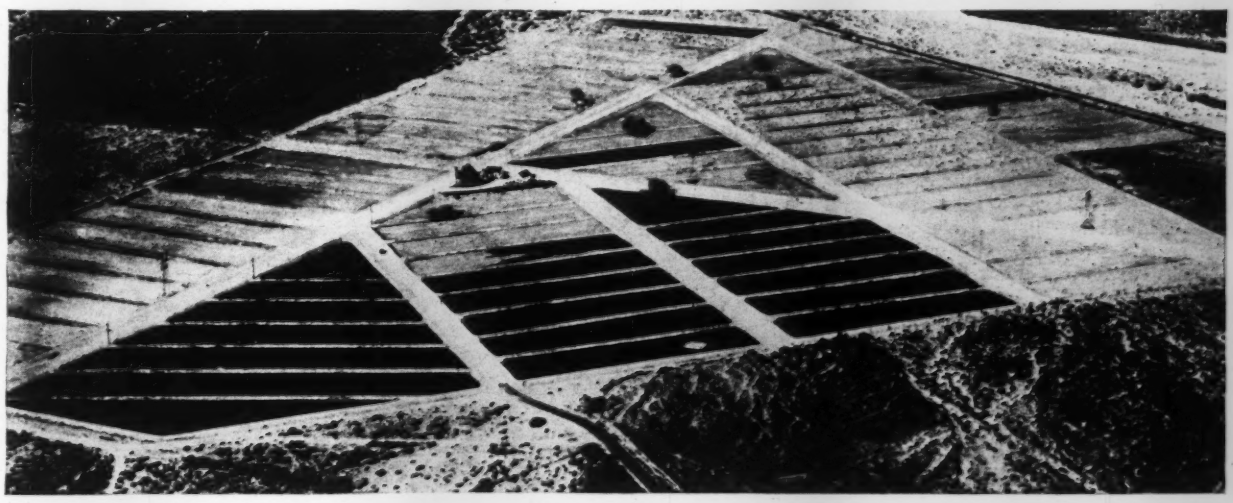
Water is delivered to the plant through a 72-in. supply line with venturi meter. When test readings are made the rates of flow into the test basins are obtained by irrigation meters set at the inlet to the 6-in. distribution line. Hourly gage readings are made on all basins in use, the depth of the water is recorded and from time to time the 6-in. valve is adjusted as may be necessary to maintain the desired water depth. The operator on duty uses a light work car, and in any emergency can call the two other shift operators, who live at the caretaker's house on the property (ordinarily the plant operates on the basis of three 8-hour shifts).

Results

Unit rates of percolation in acre-feet per day since the starting of operation have in general been found to average as follows:

1931-32	6.15 ft.
1932-33	6.92 ft.
1933-34	5.51 ft.
1934-35	6.24 ft.

Rates were higher during the years when the least water was spread, because then it was possible to concentrate the flow in those basins which gave the most rapid percolation. The low rate in 1933-34 resulted from a long period of operation with silty water. Silt came into upper San Fernando reservoir in the flood of Ja . 1, 1934, and, as all of the surplus water brought in by this flood was put through the spreading grounds, much silt had to be handled. During this period unusually frequent cultivation was necessary and the rate of percolation was very low. However, by the end of the season and after a considerable period of clear water application the usual rate of more than 6 ft.



SPREADING GROUNDS in the San Fernando Valley as seen from the air. The dark areas are basins that have been flooded with water supplied through a pipe distribution system. The flow in each basin is adjusted to maintain an average depth of 6-in.

per day was regained and has continued up to the present time, although no silt was actually removed from the basins.

The Tujunga spreading ground purposely was located so that water spread during the winter months would be available the following summer at the North Hollywood pumping plant, some distance farther down the valley. This pumping plant is served by 18 wells, 20 in. in diameter and averaging 400 ft. deep, which have a total capacity of 100 sec.-ft. The pumping plant functions strictly as an emergency unit, because if the underground flow is not intercepted at this point the water flows on underground and is available a few years later farther down the valley at points where diversion by galleries and pumps is more economical.

The importance of the San Fernando underground basin made it worth while to install water-stage recorders on key wells and make manual measurements on several hundred private wells. By observation of these water levels the effect of the spreading is clearly seen, particularly in seasons when there are no contributions from local streams to complicate the records. After water has been put into the spreading grounds its underground movement may be followed clearly for several miles.

If the high groundwater plane of 1922 is assumed as a maximum there appears to be a safe storage volume of approximately 150,000 acre-ft. available in the San Fernando basins during the average dry season. This storage, located at the most strategic point in the city's system, is of extraordinary value for regulation and emergency supply.

System Improvements

SOME practical notes on system maintenance are supplied by J. A. Jensen, Engineer of Waterworks, Minneapolis, Minn., who has been directing considerable attention toward improvement of plant equipment and existing distribution facilities. The following account briefly outlines some of the principal activities of the water department and the methods used in checking and overhauling centrifugal pumps, improving gate valve operation and eliminating leakage from mains underlying railroad tracks.

Centrifugal pumps while presenting a serious problem in upkeep occasionally require replacement of shaft sleeves and wearing rings. The sleeves eventually become scored by the packing of the stuffing boxes although the packing glands are run as loose as possible. A water seal is piped to lantern rings and a certain amount of water leakage from the seal is allowed to flow through a proper drain. Since clean water is used the packing is kept quite free from foreign matter and abrasion is kept at a minimum. In order to replace shaft sleeves or wearing rings the pump must be dismantled for a short period. If the wearing rings are flat the repair can be made by welding or swedging a ring on the impeller. The fixed rings in the case and impeller rings are then machined to a new fit. If the wearing rings are of the labyrinth type, the replacement usually involves a change of the rings. The replacement of a complete impeller is less frequent and unless the vanes crack or some defect shows up, they will last from seven to nine years without any appreciable wear.

Pump efficiencies check frequently

The efficiency of the pumping units in the Minneapolis system is determined by means of daily meter readings. Each pump set is provided with a Venturi meter, manometer, and all necessary pressure gages. On the power side are provided all the necessary electrical meters. With the data entered on the reading sheets, the efficiency of all pumps is readily determined each day on what may be called a commercial or pay basis. Bills for power are paid on the basis of these readings. The department also has a set of more accurate instruments which are set up at certain intervals for determination of the precise efficiencies of the unit; the comparative results are usually very close. Any variation from the originally determined efficiency is a direct indicator of some trouble in the pump which is immediately given proper attention.

Motors on the centrifugal pumps are of the synchronous type and unless there is damage from moisture, very little trouble is experienced from deterioration of insulation. The chief upkeep on the electrical side is in starting control equipment. This is particularly true in connection with oil switches. Possibly the latter types have been improved, but in earlier installations the contacts have to be given constant care against damage from burning or arcing.

At certain points where water mains are adjacent to or underlying railroad tracks, leaks have repeatedly appeared due to the intermittent pressure loading or vibration exerted by passing trains. In several cases this repeated maintenance difficulty has been eliminated in the following manner: the pipes were uncovered and after a thorough inspection and replacement of defective joints and specials, the whole section was supported on a concrete slab by means of properly spaced saddles that would not interfere with the accessibility of the face of the joint. In all cases where this treatment was used there have been no further leaks.

On the larger water mains, many of the gate valves have been given a thorough overhauling and inspection. In some cases the guides and gateways contained deposits of sand or sediment which prevented tight seating. Manholes have also been built to replace ordinary boxes around gates in order to provide accessibility for easier inspection, oiling and repair operations. Control gates are found to need overhauling every four or five years when they are subject to constant use. The repairs are usually replacements of wearing parts, such as guides, seats and disk rings.

De Luxe Water Sampling Facilities

An express fleet of water sample trucks in Los Angeles are regularly employed in the collection of 30,000 bacteriological analyses per year in addition to sanitary chemical, mineral, algae and miscellaneous samples. These trucks are also used in the investigation of complaints, control of algae, control of odors and tastes and reservoir treatments. The equipment includes sample refrigeration cases, supply of sample bottles and field testing equipment.

Zeolite Removes Manganese

HARD WATER from well supply at Ambridge, Pa., softened and de-manganesed economically in a split-treatment process employing zeolite and coke filters

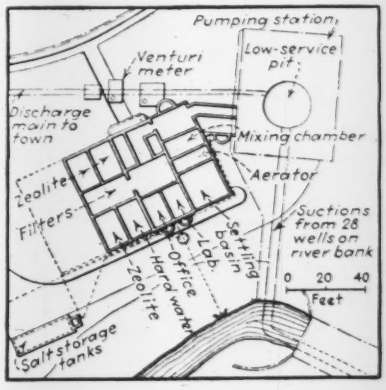
D. E. Davis and J. T. Campbell

of J. N. Chester Engineers, Consulting Engineers, Pittsburgh, Pa.

REMOVAL of manganese from domestic water supplies deservedly has been receiving increasing attention in the past few years, resulting in a body of experience which assures a successful solution of the problem even when large concentrations of the troublesome element are encountered. This fact has been demonstrated at Ambridge, Pa., where for nearly two years manganese up to 7 p.p.m. has been dealt with successfully by a combination of greensand zeolite and *pH* control through lime treatment. Hard well water is being treated in a split-treatment plant where 75 per cent is softened and de-manganesed to zero and then mixed with the remainder after the latter has been partly treated. Experience in starting operation indicated that mains could be flushed free of previous manganese deposits and that subsequently the small amount left in the water after the split-treatment process was deposited in the mains; so that none reaches the consumer.

Ambridge, like many communities bordering on the Ohio River below Pittsburgh, derives its supply from wells which tap the water-bearing sands and gravels of glacial origin deposited in the ancient rock-cut gorge beneath the present stream bed. While this groundwater is clear and safe from the sanitary standpoint, in contrast with the river surface water, it is quite hard and shows an appreciable manganese content; the manganese in the Ambridge supply is unusually high, averaging just under 5 p.p.m. Staining of clothes in laundry operations and clogging of mains and services were therefore a natural expectation and fact. The average hardness at 258 p.p.m. might be regarded as fairly high, and this coupled with the other undesirable qualities led to a widespread demand for a softer water free of manganese. This agitation gathered weight from the knowledge that other communities up river had successfully met similar situations by the installation of softening plants.

The supply is derived from 29 8-in. wells with perforated casings, driven through coarse sand and gravel to rock 36 ft. below the normal pool level of the river. The wells are in a continuous line along the north shore of the river but are separated by a small entering stream between the two groups. Drop pipes connect the individually valved wells to common suction lines which enter the 24-ft. diameter pump pit in the station.



AMBRIDGE purification plant layout.

The waters from the two groups differed, as may be judged from the tabulated chemical analyses:

	Downstream Wells	Upstream Wells
Total hardness, p.p.m.	175	265
Alkalinity, p.p.m.	104	110
Iron, p.p.m.	0.54	Trace
Manganese, p.p.m.	5.3	4.7

Pipe-mill pickling wastes discharged into the minor stream may account for this situation, as they most likely seeped into the underground waters through the gravel bottom of the creek bed. The groundwater beneath the river appears to be softer than that reaching the wells from the back country drained by the small creek, and the intersection of the waters from the two sources exerts a varying influence on the water being treated. On starting the plant in the morning after the night's shutdown, the water shows a hardness of 200 p.p.m., which gradually increases over a 6-hr. period to 250 p.p.m., at which it continues during the remainder of the day. In a single week the plant experienced nearly its lowest and its highest hardness, 216 p.p.m. and 376 p.p.m., with corresponding manganese contents of 3.5 p.p.m. and 6.8 p.p.m. respectively. The lows were occasioned by the dilutions of soft water brought by flood waters which seeped through the gravel banks. Anticipating the flood, the wickets of the Ohio River dam No. 4 were lowered, which resulted in an extremely small river flow after the recession of the flood and before the wickets were raised. There was also a corresponding opportunity for the "back-country" hard water to exert its unfavorable influence.

The construction work involved the building of a softening plant and the rehabilitation of the pumping station, including the removal of one of the two gas-driven, vertical triplex pumps (leaving the second pump in reserve), and the installation of two 1,510-g.p.m., motor-driven centrifugal low-service pumps in the pit. The average lift on these pumps was 15 ft., and on occasion has been 18 ft., which pointed to the necessity of an efficient vacuum system for priming. This was provided by a rotary vacuum pump connected to a vacuum tank with connections to the pumps through special priming valves.

Basis of design

Previous experience with zeolite plants gave confidence that the iron and manganese could be wholly removed by the greensand as long as the water was kept in the zero zone, but it was obviously essential that the lime-treated hard water should be treated for manganese removal if the final product was to be manganese-free when the hard and soft waters were mixed to give a delivered hardness of 82 p.p.m. Accordingly the design of the softening plant was predicated on the construction of three 0.5-m.g. greensand zeolite units and one similar-size quartz sand filter, preceded by lime-treatment facilities. All are of the rapid-sand gravity type with clear-well beneath.

Typical operation characterizes the zeolite softeners. The raw water from the wells is passed downward through the greensand, which by base-exchange action has the property of converting the hard water to a water of zero hardness. Each cubic foot of the sand is capable of removing approximately 3,200 grains

WATER SOFTENING and manganese removal plant adjoining the remodeled pumping station at Ambridge, Pa.

TWO of the four filter operating tables with main control table in entrance lobby.

of hardness (as $CaCO_3$), giving completely soft water during this "zero zone." At its end the water gradually and uniformly passes from zero to full hardness during a so-called "twilight period," extending the capacity of the sand about 200 grains per cubic foot. The sand is regenerated by first washing upward at the rate of 12 gal. per sq.ft. per min. to remove some of the manganese adhering to the sand grains. This wash is followed by an application of a salt solution, which introduces sodium into the greensand by base exchange, thus regenerating the sand and rendering it capable of again softening the raw water. The waste products are rinsed downward to the sewer by raw water from the wells. This operation is accomplished in about one-half hour, after which the treated water is permitted to enter the clear well.

Since variations in the hardness of the raw water were to be expected, and the hardness of the delivered product was to be maintained substantially uniform, it was evident that the rates of operation of the hard and soft water units would have to be varied to meet these conditions. In addition to the usual rate controllers on the effluent from the units, one was also placed on the inlet to the hard-water treatment plant. The hard water (roughly one-fourth of the total water treated) enters two square concrete mixing chambers with combined capacity 30-min. detention, which may be operated in series or parallel. The water is treated with lime to bring it to a *pH* of 9.5 and, after thorough mixing, is discharged over two coke trays and thence into a submerged bed of coke. This bed is confined in one end of the sedimentation basin by means of a cross-wall, whose bottom is pierced by openings admitting the treated water to the sedimentation basin. The submerged coke rests on a vitrified-clay underdrain system such as is used in a sewage sprinkling filter. The settling basin proper has a detention period of 2.7 hr. and delivers directly to the 0.5-m.g.d. quartz sand filter. The hard water, collected in the clearwell beneath this filter, is conducted to the soft-water clearwell across the pipe gallery and then mixed with the soft water from the zeolite filters to produce a final product of 82-p.p.m. hardness.

Salt for regeneration of the zeolite is delivered in carload lots to a concrete basin alongside the plant where a saturated brine solution is prepared. When needed this solution is drawn into a concrete dosing tank where it is diluted to a 10 per cent salt solution. A centrifugal pump delivers the regenerative solution on top of the zeolite bed through perforated pipes attached to the wash troughs.

In the operation of the zeolite softeners the salt dose is rinsed out until the soap test discloses a hardness of 30 p.p.m. after which the rewash drain is closed, the effluent valve opened and the softener discharges directly into the clear well. Observations of the softener disclosed that the manganese was entirely removed during the zero zone of the softening period, and that at its end as the hardness gradually increased through the "twilight zone," the manganese was still absent when the hardness was 30 p.p.m. but reached 1.4 p.p.m. when the softener was cut out for regeneration at a hardness of 70 p.p.m.

The back-washing operation at this plant produces a spectacular result, since the first flush of water is tinged a deep but clear reddish hue as the iron and manganese are washed out. Although several cycles of regeneration are possible before head loss requires backwashing, back wash is found advantageous at each regeneration, since comparative observations disclosed that a 20-min. longer run of zero water could be had than if this operation of washing were postponed until required by the head loss in the units. No deposition of iron or manganese can be detected on the individual zeolite sand grains; no diminution in exchange capacity has yet been noticed, and the loss in sand has been low.

The operation of the hard-water filter has proved highly interesting. An experimental treatment unit in which water trickled over pyrolusite (a catalytic medium of manganese ore containing 70% manganese dioxide) at the same rate as in plant operation proved that 2.5 p.p.m. of manganese could be taken out by catalytic action, but that the *pH* had to be raised if the remainder were to be removed. This experience was confirmed on a plant scale when the water was passed through the plant for several days without the addition of lime. Approximately 2.5 p.p.m. of manganese was removed by catalytic action before reaching the filter, while 0.5 p.p.m. further removal was effected in the hard-water filter itself. In normal operation the manganese removals in the various steps are as shown in the following tabulation.

	Manganese in p.p.p.m.	
	Total	Removal
Raw water	5.0	—
Water leaving mixing basins	5.0	0.0
Water at bottom of last coke tray	4.5	0.5
Water leaving submerged coke bed	3.5	1.0
Water leaving settling basin	1.0	2.5
Water at filter effluent	0.05	0.95

The lime combining with the CO_2 raises the *pH* and oxidation of the iron and manganese takes place; this reduces the hardness of the hard water 55 p.p.m. The *pH* of the raw water is 7.1 and that of the water pumped to town is 7.5. For a time the hard water was carried at a *pH* of 8.7, and although the final effluent was nearly manganese-free a dark slimy scum built up on the sand grains. Vigorous use of rake or paddle agitation of the sand at each washing was necessary in order to check this growth. At a *pH* of 9.5 approximately 1 p.p.m. of manganese reaches the top of the filter, where it is removed in the lime film on top of the sand without building up a manganese film on the sand grains.

In the early period of plant operation the hardness and manganese were reduced gradually and the water reaching the consumers had a manganese content of 1.4 to 1.8 p.p.m. When the housewives learned that the plant was in operation, many of them (against the advice of the waterworks officials) began to "dampen the wash" in the evening so that the ironing could be done in the morning. This procedure had formerly resulted in manganese stains, but under the new conditions no spots were reported. This observation would seem to indicate that the manganese which had been removed by aeration and catalytic action is the troublesome form, and that the remainder which requires a high *pH* for its removal is innocent of staining qualities.

Some question arose as to the effect of the soft water on the manganese deposits which had accumulated in the mains over the years prior to softening. For two months a schedule of hydrant flushing was inaugurated at two-week intervals at night. The old deposits seemed to be looser than formerly and the water flushed out black from the hydrants for several minutes but no manganese broke loose to enter the homes of consumers. At present the water leaves the plant with manganese at about 0.1 p.p.m. but only a trace is detectable at the spigots.

The plant has been in continuous operation since April, 1934, and the summarized record of performance since October, 1934 (when delivered water reached the intended softness of 82 p.p.m.) is given in the appended tabulation. Some of the plant statistics based on the operating experiences for December, 1935, are as follows:

Salt per 1,000 gr. of hardness removed	0.36 lb.
Salt and lime cost per million gallons	$19.28
Salt and lime cost per million gr. of hardness removed	$1.66
Exchange capacity of greensand in gr. of hardness removed per cu. ft.	3,230 gr.
Low-service pumpage used in washing and rinsing	12 per cent
Hard water as percentage of delivered product	35 per cent

Under prevailing conditions the cost of removing hardness is identically the same for lime and for salt. Manganese removal may be regarded as a costless by-product of softening.

The water rates yield a fair profit and this surplus helped defray some of the plant cost. Although the increase in costs has approximated 2.5c. per 1,000 gal. it has not been necessary to raise the rates. The total cost of the plant was $124,690.

A. W. Johns, borough manager and water commission engineer, had charge of the construction with W. M. Crawford (now chemist in charge) as resident engineer. The plant was designed by the J. N. Chester Engineers, Pittsburgh, Pa., and built by the Patterson Engineering Co., Detroit, Mich.

Mixing Experiments

PRELIMINARY treatment of water prior to filtration by flash mixing with chemicals and subsequent flocculation by slow and long-time mixing intensively studied by Armour Institute of Technology

HAROLD VAGTBORG

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THE WIDE differences of opinion regarding the value of slow mixing in the preliminary treatment of water suggested that this subject would be an excellent problem for carefully conducted research at the Armour Institute of Technology, Chicago. In the program of study now being carried out two phases of the investigation have been satisfactorily completed and the experimental procedure and results of the work to date can therefore be summarized.

The first investigation, concerning the effects of slow mixing upon the coagulation and precipitation of suspended and collodial matter in waters of varying turbidity, showed that the use of slow mixing resulted in a 20 to 30 per cent increase in clarification efficiency.

The second investigation dealt with the effects of long time slow mixing upon coagulation and precipitation in waters of low turbidity. The experimental data show remarkable advantages of slow-mixing basin periods of 1 to 1½ hr. detention and the practicability of greatly reduced sedimentation periods over those heretofore adopted as standard practice.

Plan of procedure

The plant (for description see *ENR* Sept. 13, 1934) was designed to permit flexibility of operation and is of sufficient capacity (25 gal. per min.) to assure results comparable to large plant operation. Fig. 1 shows a longitudinal section of the plant, with the slow-mixing basins arranged for long detention pediod studies of slow mixing. It will be noted that for the sedimentation basin the dimensions and allowed head losses of the various units are in accord with standard practice. Preliminary studies showed that the adopted dimensions of the sedimentation basin gave closer to normal and more reliable results than a basin of the usual 10 or 12 ft. depth which would have limited width to only a few inches in order to meet cross-sectional area requirements.

Efficiency of coagulation was determined by comparing the variations in the turbidity readings and floc characteristics of samples taken from the sedimentation basin at established testing points. Plant arrangement and operating procedure were similar for both investigations, therefore the details of only the first experiment are given; modifications required in the second investigation are noted.

To secure the data required in the first investigation three variations of turbidity, 10, 50, and 100 p.p.m., were adopted. The value of 10 was chosen as a minimum because it is practically as low as is obtained in surface supplies; 50 was used as a medium turbidity because this condition assures a sufficiency of nuclei for floc formation; 100 was arbitrarily adopted as a maximum, to check the opinion of some investigators that turbidities exceeding 50 have little if any added advantage as producers of nuclei. It is generally conceded that turbidities of over 100 are readily removed and offer no difficult engineering problems. A series of six tests was made with and without the mixing mechanism in operation.

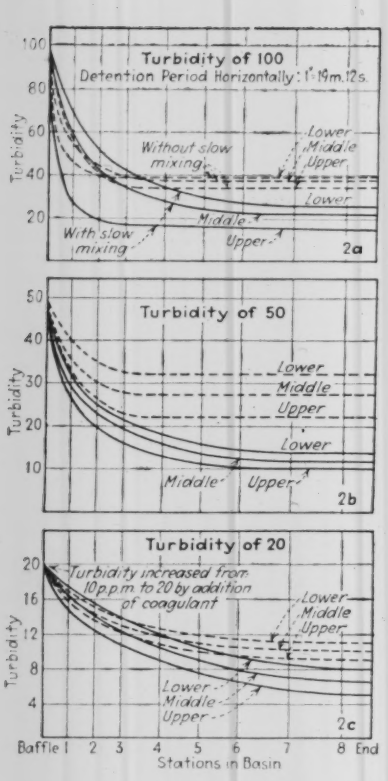

FIG. 2—RESULTANT TURBIDITIES at various distances, equivalent to time in the sedimentation basin, after slow mixing for 30 min. shown in full lines and without slow mixing shown in dotted lines.

Water Used—Three sources of water supply were available to the plant; a direct hook-up with the Chicago distribution system, an auxiliary well supply, and a connection with the raw-water control reservoirs where city water could be artificially varied to meet the requirements of quality of raw water desired. The city supply was used as it was similar in characteristics to typical surface supplies.

From studies made by C. Leipold of Winnetka, Ill., it was determined that the material best suited for producing artificial turbidity was a fullers earth known as Type A.I.T. "B". This material was fed to the raw water by a carefully calibrated dry-feeding machine just before rapid mixing.

Coagulant—Aluminum sulphate fed in solution was first considered as a satisfactory chemical coagulant but subsequent testing showed that a good floc could not be obtained with low turbidities using less than 1½ gr. per gal. Sodium aluminate in combination with aluminum sulphate was then tried and it was found that the proportion 1 gr. per gal. of the aluminum sulphate with 0.3 gr. of sodium aluminate produced an excellent floc. These proportions were then tried in the plant with satisfactory results and this combination was adopted as suitable for use in all the tests.

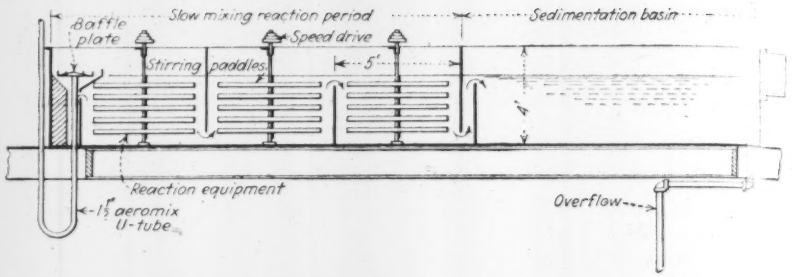

FIG. 1—THREE SLOW-MIXING basins, all in one tank 5 ft. wide, precede entry of water into sedimentation basin. The mixing units can be used independently and progressively to give 30, 60 and 90-min. slow-mixing periods. This same tank was used in both investigations but in the first experiment the paddles were set on a horizontal shaft transversely of the tank.

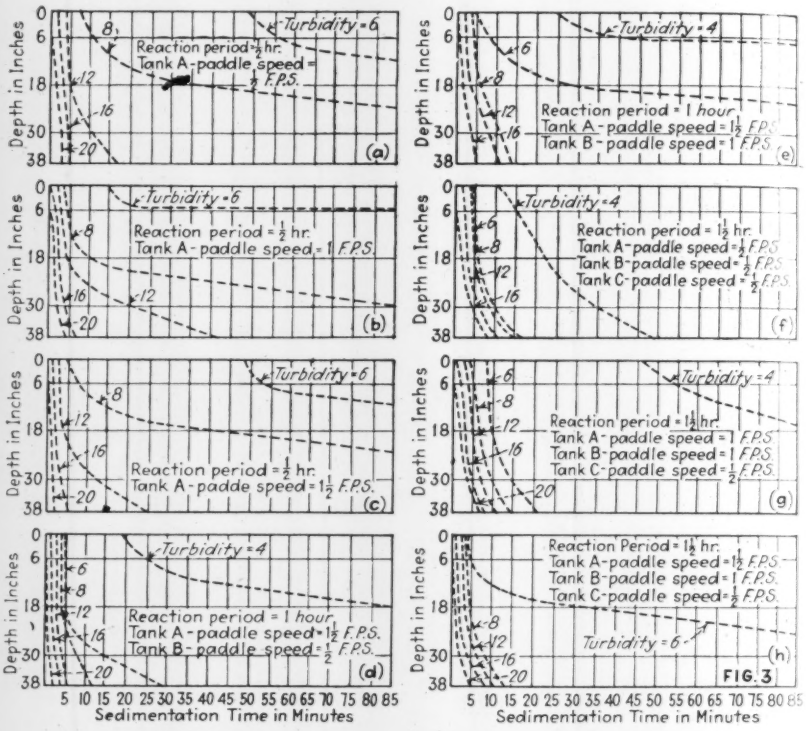
Depth in Inches
Turbidity = 6
Reaction period = ½ hr.
Tank A - paddle speed = ½ F.P.S.
(a)
Reaction period = ½ hr.
Tank A - paddle speed = 1 F.P.S.
(b)
Reaction period = ½ hr.
Tank A - padde speed = 1½ F.P.S.
(c)
Turbidity = 4
Reaction period = 1 hour
Tank A - paddle speed = ½ F.P.S.
Tank B - paddle speed = 1 F.P.S.
(d)
Turbidity = 4
Reaction period = 1 hour
Tank A - paddle speed = ½ F.P.S.
Tank B - paddle speed = 1 F.P.S.
(e)
Reaction period = 1½ hr.
Tank A - paddle speed = ½ F.P.S.
Tank B - paddle speed = ½ F.P.S.
Tank C - paddle speed = ½ F.P.S.
(f)
Reaction period = 1½ hr.
Tank A - paddle speed = 1 F.P.S.
Tank B - paddle speed = 1 F.P.S.
Tank C - paddle speed = ½ F.P.S.
(g)
Reaction Period = 1½ hr.
Tank A - paddle speed = ½ F.P.S.
Tank B - paddle speed = 1 F.P.S.
Tank C - paddle speed = ½ F.P.S.
Turbidity = 6
(h)
FIG. 3
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85
Sedimentation Time in Minutes

FIG. 3—ISO-TURBIDITIES in sedimentaion tank under various slow-mixing reaction periods and various combinations of speeds of mixing paddles. Raw water turbidity was 20 p.p.m. and ratio of volume of reaction tank to paddle area was 9.38.

Many methods of rapid mixing, including systems based on around-the-end baffles, either horizontally or vertically placed, and mechanical agitating devices were available. It was apparent to those operating the plant that a violent mix for a short period of time was desirable and was consistent with good practice. When mixing time is limited to a period shorter than it takes a coagulant to commence the process of coagulation, the violence or agitation from mixing makes little difference. Since this research program involved variations of turbidity and not of methods of feeding, mixing, etc., it was important to select a device for mixing which could be relied upon for uniform and constant action throughout the series of tests. As the aerator-mixer fulfilled all of those requirements and was available for ready installation this device was used.

The function of slow-mixing basin equipment is to flocculate the material in the water so that individual particles contained therein are brought in close contact and following the law of coagulation, unite into larger particles. It was therefore necessary that the mechanism move slowly enough to prevent the destruction of forming floc fast enough to do the work of coagulation in the least period of time. For this purpose it was decided to install a horizontal shaft through the reaction basin, transverse to the flow, on which paddles could be attached. It was found that variations in the area of these paddles and their speed of rotation, caused variation in floc formation.

To eliminate the possibility of cross

circuiting in the slow-mixing basin tests were made using dye to determine the lines of flow of water through the basin into the sedimentation tank. Originally a baffle wall was built between the two tanks with an opening of 6 in. along the bottom. The paddles were driven in such a manner as to move in a direction opposite to the flow of water through this opening but even with this provision short circuiting continued. Critical adjustments in weir and baffle wall were found necessary in order to obtain satisfactory results.

Sampling—From a general knowledge of sedimentation behavior it is apparent that most of the settleable material is deposited in the fore part of the sedimentation basin. For this reason it was desirable that sampling stations be closer together at the influent end of the basin than at the effluent. These stations were placed so that samples could be taken at various elevations in the basin. Although the tank is rectangular in shape and flow conditions should be identical on both sides, a double line of stations was established through the tank equal distances from each side, so that one row could be checked with the results of the other. The graphs show relative distances between stations. The detention period in the full length of settling basin was 3 hr.

The effect of slow mixing upon the coagulation and precipitation of suspended and collodial matter in water is evidenced in the sedimentation basin by the quality of floc and the amount of turbidity present at various stations. After trying various methods of sampling it was found that a bottomless bottle with a tapered neck, corked at the top with a bronze tube 3 ft. long inserted in the center of the cork was most desirable. In using this device the bottle would be submerged bottom first with the forefinger on the upper end of the hollow tube and air pressure within the bottle and tube prevented the water from entering until the desired sampling point and depth were reached. The forefinger would than be lifted slightly to allow the air in the bottle to escape and the sample entered the bottle. After a few trials the operator learns to manipulate the device so that the sample will enter fast enough to prevent the precipitation of the materials contained and slow enough to prevent destruction of the floc. After the bottle is pulled to the surface, the finger meanwhile being held tightly over the end of the tube, and just before the bottom of the bottle emerged from the water, a glass plate is slipped under the ground edge of the bottom.

The floc in the sample bottle consists of the coagulant, and suspended and colloidal materials which in turn determine turbidity. Agitation of the sample causes the floc to break up readily and a turbidity reading can be made. It is of importance to record the characteristic of the floc particles before agitating the sample because a prerequisite to good operating results is larger floc particles with clear water between.

Method of Operation—Before any data were taken the plant was tested for a few days under the various conditions which would be encountered. The first series of tests were based upon a turbidity of 100 with the slow-mixing basin in use. The raw water turbidity on the first test was 8 and Fuller's earth was added to make the total turbidity 100. The plant was always allowed to run for a period of three hours before taking samples as an assurance that all variable conditions were constant. The samples were taken at each of the sixteen stations and at three elevations at each station, namely, 8 and 16 in. from the surface and 10 in. from the bottom. After the character of the floc was recorded the sample was violently agitated and a turbidity reading taken by a Jackson turbidimeter. Tests were conducted in a like manner on the variations of turbidity, 10 and 50, each with and without slow mixing.

Due to the addition of the coagulant to water having a turbidity of 10, turbidity readings of approximately 20 were obtained after rapid mixing and prior to slow mixing. This higher figure was used as the initial reading in the tests on turbidity 10 water. Turbidity was similarly increased on the 50 and 100 tests but the effect is not pronounced so therefore the 50 and 100 are retained in the graphs as starting points.

Results and conclusions

First Investigation—As noted in the graphs (See Figs. 2a, 2b and 2c) slow mixing is beneficial to the extent of 20 to 30 per cent greater reduction in suspended material and these benefits are obtained by proper rapid mixing for at least 30 min. after complete diffusion of the coagulant throughout the water. Not only is the rate and amount of precipitation increased but the floc is increased in size so that whatever passes to the filter bed is large enough to be retained on the surface and can not penetrate the bed to accelerate clogging and decrease the length of filter runs.

It is interesting to note from the graphs that a turbidity of over 50 does not materially increase settleability of floc. It may be that a turbidity of 30 or 40 is sufficient. Such a determination would have value only to the operator who considers the purchase of material for artificial turbidity to improve plant operation and desires to get the best results at least cost.

Second Investigation—As the second investigation was made in an effort to obtain proper coagulation in water of low turbidity by long time mixing, it was decided not to exceed turbidities of 20. Artificial turbidity was at no time added. Although the raw water turbidity was usually 10 or 12 the presence of the small amount of coagulant added brought the turbidity of the water entering the reaction basins to approximately 20. Aluminum sulphate, 1 gr. per gallon, alone was used. Three slow-mixing basins of 30-min. detention each were provided in the inlet end of the sedimentation basin so arranged that they could be added one at a time to give 30, 60 and 90-min. detention periods. An under- and an over-baffle preceded the inlet into the sedimentation basin and separated the slow-mixing basins when more than one was used.

A churning-action was produced in the slow-mixing chamber by three vertical shaft paddles, one in each chamber. The paddles were constructed of ¼x1½-in. laths 4½ ft. long, each set possessing a total area of 8.55 sq. ft.; this paddle area operating in a 5x5-ft. reaction chamber 2½ ft. deep, gives 9.38-cu.-ft. capacity per sq. ft. of paddle area, and is within the recommended range as found by Leipold. (See AWWA *Journal* for August 1934). All paddle velocities refer to peripheral speeds.

It was not the purpose of this investigation to determine the optimum paddle speed for the various periods, or to determine the effects of the varying speeds upon coagulation; however, a variance of such speeds was applied in order to obtain the bast coagulation under existing operating conditions with each of 30, 60 and 90-min. periods of slow mixing. The peripheral speeds selected were 1½, 1 and ½ ft. per sec., based upon the results of Nolte and Kramer (see AWWA *Journal* September, 1933) (i.e. 0.5 to 1.5 ft. per second at the two-thirds point), and Leipold (same article) who recommended speeds of 0.5 to 1.5 ft. per. sec. For the purpose of comparing the data obtained under various operating conditions, i.e., with variable reaction detention periods and paddle speeds, it was decided to prepare "iso-turbidity" graphs. An iso-turb may be defined as an imaginary line connecting points in a longitudinal section of the sedimentation basin, at which the turbidity is the same. Thus at a glance the turbidity at any point in the sedimentation basin may be obtained by interpolation between iso-turbs. The slope of the individual curves is a measure of the rate of settling, or by definition the effectiveness of the coagulation.

Slow mixing benefits

The best results obtained with a 30-min. slow-mixing period show the removal of turbidity 12 from the tank after 17-min. sedimentation (see Figs. 3 *a*, *b* and *c*) turbidities 6 and 8 persisting even after 85-min. detention. With an increase in slow mixing to 60 min., turbidity 12 was removed entirely from the tank within as little as 6-min. sedimentation; turbidities 8 and 6 being removed in 12 and 27 min., respectively, turbidity 4 persisting throughout the 85-min. detention period (see Figs. 3 *d* and *e*). With a further increase in

the slow-mixing period to 90 min. (see Figs. 3 *f*, *g* and *h*) turbidity 12 was entirely removed from the sedimentation basin after 11-min. detention: the turbidity 8, after 15 min.; of 6 after 17 min.; of 4 after 48 min.; leaving suspended matter equivalent to a turbidity below 4, yet above 2, to persist throughout the sedimentation detention period, in this case only 55 min. Corroborating results were obtained by visual inspection and comparison of the type of floc produced in the three slow-mixing basins while all three were in operation. Samples removed from chamber *A*, with an average detention of 30 min., contained but pin-point particles as its floc characteristic. The floc in chamber *B*, with an average detention of 60 min., was of a much more substantial composition, the particles being much larger and seemingly containing more body. A further improvement in the quality of the floc in chamber *C*, averaging 90-min. detention, was noted. This improvement over that in chamber *B* was not so pronounced as that effected between chambers *A* and *B*. From the foregoing analysis it is apparent that:

1. Extended periods of slow mixing are highly beneficial.

2. Increasing the slow-mixing period from the customary 30 min. to 60 min. results in a material improvement in coagulation and precipitation. To produce the identical quantitative removal of suspended and colloidal matters as could be produced with 30-min. slow mixing and 85-min. sedimentation, only 5- to 10-min. sedimentation was required with 60-min. slow mixing.

3. Increasing the slow mixing to 90 min. produced a further improvement in sedimentation, though not as pronounced over the 60-min. period as the improvement of the 60-min. over the 30-min. period. Although 30-min. sedimentation with 90-min. slow mixing produced as good results as 85-min. sedimentation with 60-min. mixing, the values after 30-min. sedimentation, in each case, are not much different.

4. With proper coagulation, such as is effected with either 60 or 90-min. slow mixing, sedimentation basin detention periods may be greatly reduced from those now used in present practice.

5. Although no conclusive experiments were attempted to determine the most effective paddle speed for slow mixing, sufficient indications were produced for the qualified conclusion that a peripheral speed of 1½ ft. per second is probably too fast, and tends to break up a portion of the floc it produces. The most satisfactory peripheral speed is probably somewhere between ½ ft. per sec. and 1½ ft. per sec. closer to the former value than the latter. A slight amount of settling in the slow mixing basins was noted at the lower limit.

Personnel

Acknowledgment is given to T. Westerberg, S. Carlson, E. Beard, A. Hill, M. Kaminsky, H. Meyer, E. Smith and C. Thomsen, research municipal and sanitary engineering graduate students of the Armour Institute of Technology, for their assistance in conducting these investigations.

Taste and Odor Control

GRANULAR carbon filters as an adjunct to powdered carbon treatment assure complete removal of tastes and odors from a shallow lake supply at Oshkosh, Wis.—Experimental procedure and design of filter installation outlined

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PLANT scale experimental studies at Oshkosh, Wis., to determine the most practical scheme for controlling a serious condition of tastes and odors that could not be eliminated by powdered activated carbon alone, led to the conclusion that granular carbon filters in combination with the powdered carbon would furnish absolute assurance of complete removal. Adoption of this recommendation led to improvements now being made at the water treatment plant which include the installation of four upward flow carbon filtration units, each with a capacity of 1-m.g.d., additional mixing facilities and coagulation basin changes.

Oshkosh is located on the west shore of Lake Winnebago from which its water supply is drawn. The Fox River provides the major inflow into the lake at Oshkosh and the lower reaches of the river are swampy and contain numerous large lakes. Lake Winnebago itself is a relatively large body of water having a length exceeding 30 mi., and a width averaging 8 mi. It is quite shallow, however, with very little of its area exceeding 12 ft. in depth. The shallow average depth is unusual for so large a body of water and is believed to be largely responsible for the abundant algae and other fresh water growths.

The Oshkosh waterworks intake, located almost directly in the path of the outflow of the Fox River into the lake, is particularly affected by the discharge of that stream in addition to the seasonal effects resulting from the luxuriance of the algae and other water growths in Lake Winnebago and at times the color will vary from 40 to approximately 200 p.p.m. in a one- or two-day period. Probably as a result of the dry cycle prevailing from 1930 to 1935, the plant growths in the lower rivers and in Lake Winnebago have been more abundant and the resulting tastes and odors in the public water supply more accentuated than in prior recent years. The situation had become so acute in 1934 that although the water supply was treated by a modern water filtration plant in which powdered carbon had been used up to an amount of 50 lb. per m.g., the taste and odor in the water were such that there was a popular demand that the lake be abandoned as a source of supply and a well supply developed.

Engineering advice was secured and the consultants recommended that the present filtration plant be operated over an extended period as a full scale experimental plant to demonstrate the practicability of methods and the costs of taste and odor prevention and elimination.

The factors influencing this recommended action were: (1) The considerable expenditures already made for the lake water supply including a 6 m.g.d. filtration plant, (2) the further fact that the entire distribution system had been built radiating from the pumping station and filtration plant, and therefore would require expensive adaptation to a spread well development, (3) the softer quality of the lake supply as compared to well water, and (4) the marked advancement in recent years in the control of tastes and odors in water supplies.

The Water Commission authorized this procedure and the consulting engineers with the assistance of John R. Baylis, supervised the operations of the filtration plant on that basis for several months. During this period the program which is now in the construction stage was formulated and proved.

Experimental work was started early in July 1934 and continued until April 1935. Daily observations were made to determine the odor threshold number (the greatest dilution in which an odor is detectable is known as the threshold point; comparative results are

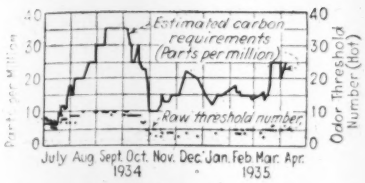
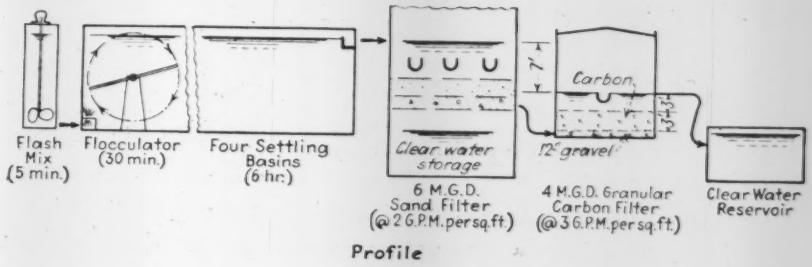

Estimated carbon requirements (Parts per million)
Raw threshold number
Parts per Million
Odor Threshold Number (Hot)
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr.
1934
1935

FIG. 1—CARBON requirements for treating the Oshkosh water supply as computed from odor determinations showed there was no direct relation between them.


Flash Mix (5 min.)
Flocculator (30 min.)
Four Settling Basins (6 hr.)
Clear water storage
6 M.G.D. Sand Filter (@ 2 G.P.M. per sq. ft.)
Carbon
12" gravel
4 M.G.D. Granular Carbon Filter (@ 3 G.P.M. per sq. ft.)
Clear Water Reservoir
Profile

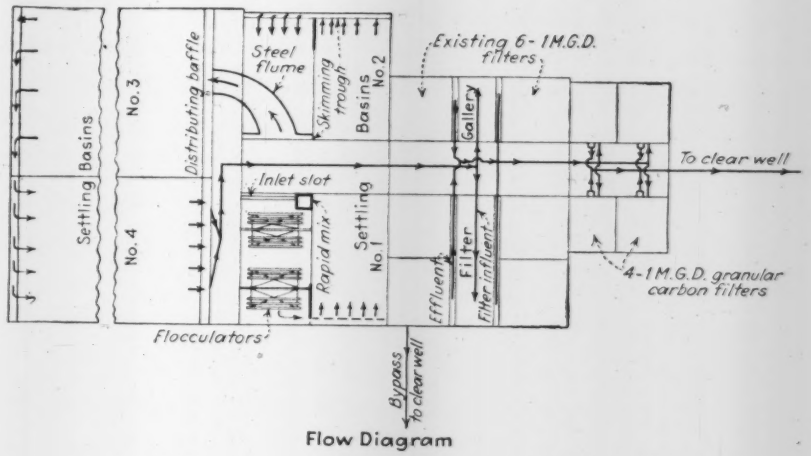


FIG. 2—PROFILE and flow diagram of the treatment plant showing the general layout, relative elevations and capacities of various units.

expressed in terms of the threshold number which is 100 divided by the percentage of the sample in the diluted portion) of raw and tap water in both hot and cold samples. Odor determinations for required powdered carbon dosage were included and although during much of the time carbon feeding facilities were inadequate to remove all tastes and odors the data secured formed a substantial basis for estimating costs. A granular carbon filter was operated to exhaustion as demonstrated by odor determinations made on the effluent.

The effects of ozone treatment and the combination of partial lime softening with filtration and aeration by fine spray nozzles, were also observed.

The determination of odor threshold numbers and computed carbon requirements are indicated graphically in Fig. 1. This shows that there is no direct relation between raw odor threshold number and carbon requirements which vary with the type of odor present. Neither is the reduction of a specific odor a straight line variation with the amount of carbon used. Recently the plant chemist reported that carbon fed at 146 lb. per m.g. reduced the hot odor threshold number from 11 to 2 but that laboratory experiments showed it required 300 lb. per m.g. to reduce the threshold number to 1 hot.

It was found soon after the investigation started that the carbon requirements were much greater on an average than had been anticipated and as the tests progressed the prevalence of tastes and odors was also found to be more continuous than had been anticipated. The results of the experimental work led to the following conclusions:

1. Activated carbon is the only practicable means of removing the tastes and odors from the Oshkosh water. The desired results can be obtained either by (a) adding powdered carbon to the water which can later be settled and filtered out, or (b) by filtering the water through beds of granular activated carbon, or (c) by a combination of the two methods.

2. The addition of lime for partial softening had no appreciable effect on odor reduction.

3. Ozone treatment was only partly effective in the reduction of odor under conditions prevailing at Oshkosh.

4. Aeration, previously provided in the treatment plant, was not of sufficient benefit to be worth while.

5. The powdered activated carbon requirements based on the test period results varied from a minimum of 50 lb. to a maximum of approximately 300 lb. per m.g., with an annual average of 160 lb. per m.g.

6. A granular carbon experimental filter run to exhaustion showed a capacity of 7,450 gal. of water per lb. of granular carbon—the equivalent of 120 lb. of carbon exhausted per m.g. This filter was operated during a period when the powdered carbon requirements averaged 176 lb. per m.g.

7. The efficiency of the granular carbon as compared to the powdered variety (with the powdered carbon used in connection with the inadequate mixing facilities available at Oshkosh) was in the ratio of approximately 3 to 2. Accordingly, if the powdered material cost 6½c. per lb., 10c. could be paid per lb. of the granular material if there were no costs other than the price of carbon. It is of course obvious that the granular material could not be used without building structures and piping to accommodate it. The cheapest quotation that could be secured at that time on granular carbon of satisfactory quality was 16 to 18c. per lb.

In view of the fact that powdered activated carbon was found to be the cheapest form of applying carbon treatment, but that granular carbon filters offered the only absolute assurance for the complete removal of tastes and odors at all times, the engineers recommended that these filters be used in addition to powdered carbon. It was suggested that the carbon filters be installed in series with the present sand filters as a finishing process.

Filter design

These recommendations were adopted by the Board of Water Commissioners after which plans were drawn and contracts let. The construction now in progress consists of the following alterations and additions to the existing filtration plant:

Granular carbon filters—The granular carbon filter installation consists of four upward flow units each having a capacity of 1 m.g.d. when operating at a 3 g.p.m. rate.

The influent coming in at the bottom of the tank is taken directly from the effluent controllers of the sand filters. The under-drainage system is of perforated cast iron pipes overlaid with 12 in. of graded gravel and 3 ft. of granular carbon. There is 3 ft. freeboard between the top of the carbon and the lip of the trough over which the effluent is skimmed before it passes to the clear water basin. The effluent trough of the carbon filters is set so as to permit a maximum loss of 7 ft. head on the sand filters.

The granular carbon filters are housed in an addition to the sand filter structure. The carbon filter building is provided with no illumination other than from electric lights. This is to prevent plant growths in the filters. The

carbon filters being of the upward flow type, the space between the filters and the operating gallery is provided with sliding glass partitions to prevent contamination of the filter water. Because the filters are upward flow, there is no control other than that for the elevation of the effluent trough.

The granular carbon was specified to be sufficiently hard to prevent crushing and disintegration while in service. At least 99 per cent (by weight) of the carbon must pass a 4-mesh sieve having openings of 4.76 mm. and not more than 3 per cent shall pass a 14-mesh sieve having openings of 1.41 mm.; other intermediate gradations are also specified.

The carbon was also subjected to a "wettability" specification of not more than 2 per cent by weight floating after application to water for two hr., and following submergence for 24 hr. (after having been thoroughly washed to remove the dust and fine particles) it was specified that none of the carbon should be in motion when the upward flow of the water through the bed is 3 gal. per sq.ft. per min.

In taking bids for granular carbon, each bidder was required to state in his proposal the phenol adsorption number (which should be not less than 4.0) and prices were compared on the basis of dividing the phenol number by the price bid per pound.

Carbon feeding equipment—During the experimental period a duplicate dry-feed powdered carbon machine was installed. The two machines provided a capacity of 860 lb. per 24 hr. With the dry feed equipment and inadequate mixing facilities it was difficult to secure a proper diffusion of the powdered carbon, and considerable dust accumulated at the point where the carbon was fed. As a part of the present improvement, an additional feeder of the solution feed, carbon suspension type with a capacity of 1,800 lb. per 24 hr. has been installed. The new equipment provides mechanical paddle agitation to wet the carbon and keep it in suspension. In its early operation this was not always accomplished but with changes, particularly in the surface agitation, it is believed the difficulties of getting and maintaining the powdered carbon in suspension will be overcome.

Mixing facilities—The only mixing mechanism in the present plant was that offered by two units of the aspirator type. In order to properly mix the large amounts of powdered carbon as well as alum and lime with the water, the new installation includes a rapid or flash mixer with a motor-driven propeller installed in a compartment providing about 5 min. detention at the inlet end of the first settling basin. This is followed by approximately 30 min. slow stirring with equipment of the flocculator type. The flocculator equipment is installed in the first of the four settling basins.

Coagulating basin changes—The capacity of the coagulating basin at the plant was quite adequate, amounting to approximately 6 hr. at rated capacity, but more than 20 hr. at the average rate at which the plant now operates.

Changes in the basins consisted of the installation of baffles and skimming troughs so that the four basins will ordinarily operate in series. Even with the cross currents and inadequate inlet and outlet control, it was found that the basins were quite efficient. The turbidity of the influent to the filters rarely exceeded 10 ppm. There was, therefore, no material tendency toward filter clogging even with the powdered carbon dosage as high as 200 lb. per m.g.

At one time during the operation of the experimental plant, black water trouble was reported in the distribution system. It was found that the color was imparted by powdered carbon which had evidently passed the filters during a time of weak flocculation. In order to prevent the recurrence of this each filter is now equipped with a floc detector. This is simply a small glass vessel through which a portion of the filter effluent is passed continuously by siphon action. The vessel is enclosed and illuminated by a beam of light in such a way that particles of floc are readily observed. With this device any passage of floc can be readily interpreted as a signal for back-washing the filter promptly.

All the work was carried on under the direction of Alvord, Burdick & Howson with the assistance and cooperation of John R. Baylis, physical chemist, Chicago.

Sulphate Scattered Dry

ALGAE control in Los Angeles reservoir system is made more effective by dry dissemination of crystals in graded sizes —Adaptation of blower for dispersion

R. F. GOUDEY

Sanitary Engineer, Bureau of Water Works and Supply, Los Angeles

THE SEVENTEEN large, open reservoirs serving Los Angeles, having a combined area of some 4,000 acres and a total capacity of 174,000 acre-ft., annually require 100 to 150 tons of copper sulphate for algae control. Until three years ago it was the practice to treat the reservoirs with a fixed dosage based solely on the area to be treated and regardless of the type of organism to be killed, the chemical analysis of the water, or the water temperature. This dosage had been determined by experience as that actually required to cover the reservoirs. Recently, methods have been developed which completely revise the former practices. Dry dissemination using crystals in graded sizes has made it possible to get effective application at depths that can be controlled accurately. Further experimental work on dispersion with blowers now is under way. In the following are given an outline of the new dissemination methods and results of their application in reservoirs of the Los Angeles system.

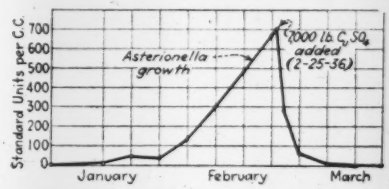
The basis for accurate determination of the proper copper sulphate dose was announced by Moore and Kellerman in 1904 when they showed that the algicidal power of copper sulphate varied not only for each specific organism which it was desired to eradicate but that it had to be corrected by (1) a 2½ per cent increase or decrease for each degree of temperature above or below 15 deg. C.; (2) a 2 per cent increase for every 10 p.p.m. of organic matter; (3) a 0.5 to 5.0 per cent increase for each 10 p.p.m. of alkalinity; and (4) a 5 per cent increase when the carbon dioxide content is low. In southern California the seasonal reservoir temperature varies from 40 deg. F. to 80 deg. F., the organic matter fluctuates from 10 to 20 p.p.m., carbonate alkalinity at times reaches 60 p.p.m., bicarbonate alkalinity varies from 100 to 150 p.p.m. and carbon dioxide is usually zero. For such conditions as these, corrections to the basic theoretical dosages at times exceed twice the theoretical values. Moreover, certain organisms such as *Anabaena* start their growths at the surface of the water and thus the vertical zone which needs treatment is limited to a few feet in depth. Again other organisms can be

reached only when the soluble copper penetrates to depths exceeding 30 ft.

In actual practice the minimum amount of copper sulphate which can be applied to reservoirs by the old method of dragging the chemical in sacks from boats, is about 25 lb. per acre. Dosages as low as 5 lb. acre have been applied, it is true, but such treatment does not really cover the entire reservoir and is not effective. The dosage of 25 lb. per acre is five times the minimum theoretically sufficient for average treatment. This hiatus between theoretical and practical dosages suggested development of a new method that would permit closer approach to theoretical needs.

Under the old method, where surface treatment was desired, minimum amounts of copper sulphate were used in the sacks which were dragged in lanes often too far apart to obtain coverage. However, if a surface treatment is desired the lanes should be close together and the amount applied in one lane should be light—a discrepancy which illustrates the inadequate control under the old method. Again, where depth treatment is desired the old method necessitated overtreatment of the top water and the use of lanes close together to get sufficient chemical down to the depth where treatment was needed. In other words, there was gross overtreatment of the surface water in order to get adequate depth treatment.

Copper sulphate as it goes into solution immediately fans out into a cross-section area about 3 ft. wide and 2 ft. deep. Depending upon the speed of the boat and distance between lanes of travel, the concentration with a feed of 25 lb. per acre varies from 50 to 100 p.p.m.—a gross overtreatment. The solution of copper compound settles faster than it diffuses laterally. In fact, in many instances it has very little lateral diffusion except under wind and wave action. Under favorable conditions the overtreated cross-section, within a few minutes' time, widens out to a width of 12 to 20 ft. but its depth increases to 30 to 50 ft., giving a concentration of copper compounds of 0.1 to 10 p.p.m. This again represents overtreatment so far as depth is concerned and leaves much uncertainty about covering the entire surface with required concentration if the lanes of boat travel are more than 15 to 20 ft. apart. Moreover, the copper in this wider zone as it lies quiescent in the water is presumably in an intermediate, basic carbonate form. Its effectiveness after a 15-min. interval is questionable. When the copper compounds form a floc or definitely are in a hydroxide form the copper rapidly settles out. There are occasions in which copper hydroxide floc settles out long before the copper can diffuse laterally more than 15 ft. from the point of application. There are indications that under favorable conditions where carbon dioxide is present copper remains in solution for several hours. Observation of these phenomena confirms the belief that the old procedure of applying copper sulphate is crude, wasteful and inefficient.



CHARTED RESULTS of Chatsworth reservoir treatment showing complete destruction of severe Asterionella growth.

An improvement on the old method

Some of the changes made to improve methods of application have been the use of power boats in place of row boats, installation of booms to space the sacks of copper sulphate farther apart, the use of double thickness sacks to slow up the dissolving rate, supports to keep burlap sacks open at the top as they are dragged in the water thus facilitating a uniform and regulated feed of chemical into the sacks by ladles, scoops or hoppers. Metal cages have been substituted for the burlap containers and there has been some improvement in specifying smaller crystals to permit of slower dissolving. Attempts have been made to spread copper sulphate in spray form over the water surface. While this might be ideal for surface growths, it does not permit treatment to predetermined depths. In short, none of these changes had corrected the fundamental defects in the old method.

An entirely new principle of application, therefore, was devised to suit the requirements of the Los Angeles system. This involved the selection of small sized crystals which will dissolve when spread uniformly in a dry form over the surface of the water. The crystals sink to a depth to which treatment is required before complete solution is reached. Thus, by varying the sizes of the crystals, copper in ionic form can be carried down to the depths at which treatment is prescribed. Dissemination of the crystals is accomplished by a specially designed "broadcaster" consisting of a hopper from which a constant feed is delivered to a "scatterer." The hopper holds 250 lb. of copper sulphate in dry crystal form carefully screened to the desired size. A graduated orifice can be adjusted to regulate the feed from 5 to 50 lb. per minute and the scatterer proper is a beveled and baffled vertical disc driven at 1,400 r.p.m. by a ½-hp. gasoline motor. As the disc is spun the crystals fed down upon it are spread broadcast over the surface of the water.

If it is desired to treat only the water within 3 ft. of the surface crystals of the smallest size are used. To treat water for a depth of 15 ft. material passing through a No. 16 screen is used and so on. Crystals of 5 milligrams weight are employed to treat water to 100-ft. depths. Crystals passing the No. 16 screen usually dissolve by the time a 4-ft. depth has been reached.

A typical result from use of this new method is shown in Fig 1 which records determinations at Chatsworth reservoir made in February of this year. This reservoir has an area of 600 acres. When a growth of Asterionella had reached 670 standard units per cubic centimeter, a completely successful treatment was made by the application of 7,000 lb. of copper sulphate in a 6½-hour period. The rate at which Asterionella died is strikingly illustrated in the diagram (Fig. 1) which shows that within a 3-week period after this single treatment the count had reduced to zero. As Chatsworth reservoir is shallow and particularly difficult to treat, this test was considered a critical one for the new method. By the old method 5 tons of copper sulphate would have been used, the time of treatment would have been two days and the results would have been far less satisfactory.

By dry dissemination an approximate saving of 60 per cent of material is made when minimum dosages are required. Saving in time of treatment also is an important item. Because no sacks have to be dragged in the water the launch can make faster time, there is no delay to fill wet sacks with chemical, wider distances between boat lanes are permissible, there is less weight per trip and fewer trips. Averaging the time of treatment of all the Los Angeles reservoirs shows four hours by the new method as compared to twelve hours by the old method. Thus treatment of a reservoir often can be completed before wind and wave action develops to disrupt continuity. Handling of the chemical is simplified and a 60 per cent labor saving can be expected when dry dissemination is used.

Experiments are being made with a blower designed to replace the scatterer. The principal advantage of the blower will be that the copper sulphate can be dumped into a hopper at the bottom of the boat whence it will be sucked up automatically into the blower which can be controlled accurately as to direction of discharge. This would be particularly advantageous on a windy day and on a calm day should have all the advantages of broadcasting with the disc type scatterer.

Another advantage will be that the blower should impart much the same speed to large and small particles alike, whereas the scatterer literally bats each particle and thus throws the heavier particles much farther than the material of smaller size. The blower should reduce the number of lanes and still further speed up the time of treatment.

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Preparation for Progress

IT IS A TRITE statement to say that community water supply is the basic service of civilized life. Trite, yet supremely true—and supremely important, for this truth defines with impressive clearness the responsibilities that rest on the water service profession and its associated industry. From its early industrial beginnings the art of water supply has grown to professional dimensions, not alone in engineering but quite as much in operation and administration; the industry has itself become a professional agency. Especially today, under intensified demand for higher levels of water service, this professional body needs the strength of close-knit organization that will weld together all its component groups for joint action; and with this it needs a purposeful directive toward progress. These are indispensable fundamentals if it is to meet its public responsibilities, responsibilities that are peculiarly imperative today, when economic activity is reviving, when housing construction faces a new boom, and when the water-service field is working for higher efficiency and economy as reflected in the preceding pages of this issue. Only if it is efficiently organized and has a broadly conceived program to guide its course, can the waterworks profession feel prepared to meet tomorrow's demands.

Guaranteed Roadbuilding

A GUARANTEED HIGHWAY CONSTRUCTION program of half a billion dollars annually for three years is assured by legislation now in the final step of being approved by Congress. With the coming July, then, highway building will be taken out of the federal dole category and become again a self-respecting contractual agreement of sovereign states with a federal Congress. This restoration of independent state road administration and of state responsibility for sharing in highway investment is of far greater value than the amount of the appropriation itself. But, supplementing this valuable effect, the appropriation goes many millions beyond those of past regular federal-aid legislation. The present appropriation includes secondary roads and grade crossings, which for 1938 and 1939 are allotted $150,000,000—to be matched by state funds—and also includes provision for toll-bridge purchases. All in all the present Congress has shown wise liberality in its enactments for road transport. Highway interests should see that these enactments proceed to execution without being paralyzed by the intrusion of work-relief control.

Labor in House Building

A FEW DAYS AGO the President joined the ranks of a growing army of economic well-wishers by stating that what the country needs is mass production, à la Detroit, of lowcost houses. Actually what is needed is someone to convince the leadership in the building trades unions that building mechanics could make more money if their hourly rates were reduced to reasonable proportions. Factory-produced houses cannot be a success until the opposition to them on the part of building labor is removed. And this opposition will be militant so long as building labor feels that mass production of houses threatens its earnings. Hardly anyone will maintain that building labor is overpaid in annual earnings. But the man who can afford a low-cost house cannot afford to pay his labor $1.10 an hour. Consequently he doesn't buy a house—and building labor as well as the man desirous of acquiring a home suffers accordingly. If the President wants mass production of houses, his influence with union labor is the best tool at hand for the purpose.

Engineers Recognized

THE IMPORTANCE OF ENGINEERING in an undertaking that to the layman may appear to be chiefly architectural has been recognized by the directors of the New York World's Fair through the appointment of an engineer, W. Earle Andrews, as general manager, and the inclusion of engineers on the planning board. Having an engineer as manager of a world's fair is not new; Lenox R. Lohr ably filled that position at Chicago. But it is an innovation to have engineers brought into the early planning. The lack of engineering forethought, especially in the matter of transportation within the fair grounds, has been all too apparent at the fairs of the recent past. Essential engineering has had to be fitted to an adopted architectural plan instead of being made an important element of that plan. At New York, development of the plan is being carried forward in the latter way. Engineers were first called in some months ago to advise the World's Fair corporation as to whether adequate foundations for buildings could be provided in all or part of the area upon which it was proposed to build the fair. Now that the site has been found acceptable they will assist in planning and placing the structures that the architects propose. Both the public and the fair corporation should benefit through this fuller recognition of the fact that engineering as well as architecture is an essential element of such an undertaking and needs to be considered from the beginning.

Logrolling vs. a Policy

IN A HANDSOMELY done booklet a Pittsburgh organization called the Tri-State Authority attempts to create sentiment for federal expenditure to protect Pittsburgh and other upper Ohio River cities from future floods. Prepared with the skill of the professional sales literature producer, the booklet is in form as well as in substance a selling document, designed to bring in the money—in this case not that of the random investor but national treasury money. It represents logrolling in new guise, calling on the aid of the publicity man's art. It fails to say that there are many rivers subject to destructive floods, and that many other communities and regions need protection. It does not propose a countrywide attack on the flood problem, in which the Pittsburgh problem would be only one item, to be considered in its proper way with due justice to the others. By arguing the claims of the upper Ohio alone the booklet creates confusion in respect to our national flood problem, rather than serving to clarify it. The

prime need of the present, however, is that out of the confusion of thinking and motive there be evolved a firm, solid foundation policy for flood control, and toward this end each of the communities concerned should give its aid. Logrolling for this or that community is not helpful; it can only plunge us farther into extravagant national expenditure and abdication of the sense of local responsibility and initiative. It is time to forget and discard the publicity slogan that "flood control is a federal problem," and proceed to build a flood policy that will be workable and sound.

Federal Aid and Bridge Purchase

INAUGURATION of a movement by Congress to buy private toll bridges with federal aid is a noteworthy change in road administration. Its constructive value remains to be learned from its results. Obviously it will not open new ways for traffic nor improve the existing ways. Nor will it relieve traffic of undue burdens, since few bridge toll rates can fairly be called burdensome. Although the bill might prove desirable in removing certain discriminatory charges to which road traffic is subjected at some points while free at others in another respect it is open to serious question.

This question indeed is of such gravity as to suggest that the bill should be reconsidered before it can set a precedent and perpetuate the system which it is intended to create. The plain fact is that the bill represents the first departure from the underlying principles and purposes of the federal-aid system of highway development. If its influence should cause these principles to be forgotten and discarded, the important federal-aid purposes would be so debased that the result could not be regarded other than as a calamity.

Federal aid was founded on the principle of guiding and encouraging state action in developing the highway system, and thereby coordinating the evolution of what is inherently a national facility and but for precedent and interpretation would be built and administered as such. Federal highway aid had no subsidy aspect; it was not even a financing device. It had no concern with anything that did not *improve* the road network. In these facts lay its strength.

Federal aid earned universal respect and admiration. Because its every detail of application was concerned only with road improvement, and because it was directed to extending the national highway system and making it a more efficient transport machine, the federal-aid plan operated powerfully to develop cooperative, progressive road action by the 48 states. It was through this effect that our roads became the foremost example of a countrywide service facility, uniform in excellence and value.

Buying toll bridges is not road improvement. It does nothing to create more paths for transport or increase the efficiency of those we have. It does not extend or perfect the national network. It represents no road progress. And, being a mere shift of service charges from the road user to the taxpayer, it is in effect a local subsidy, profiting the local toll-payer at the cost of taxpayers elsewhere. All these effects are wholly alien to the ideals of the federal highway aid system.

It is true that no one state will benefit more than another, as the bill requires the federal contribution for toll-bridge purchase to be deducted from the federal aid available for other road uses. This very fact, however, constitutes an objectionable effect, since money intended to be used for developing and improving the road network is diverted to a foreign purpose. Incidentally, if the history of Congressional action can be taken as a guide, it is not improbable that the deduction of bridge-purchase contributions will not long be maintained, and that such purchase money will in a short time become an added item separate from the normally allocated federal aid. Its pork status will then be obvious and unmistakable.

If we would maintain the federal-aid doctrine in its original clearness and single purpose, it is vital that we keep *road improvement* as sole criterion of national contribution to local road funds. If as part of this road improvement there is need for increased allocation to bridges, ample room can be found for effective use of such money. Whoever travels even a short distance by road knows the startling frequency of the warning signs, "Dangerous bridge," "Caution—Narrow Bridge," "Load limit 4 tons," and the like in varied form. These are among the disgraces of our present road transport network. Federal aid road improvement has a wide field for useful work here. But money devoted to bridge purchase will do nothing to improve dangerous bridges. On the contrary it will reduce the funds available for better bridges. It will retard the attainment of safety in bridges, just as it will set back road improvement by destroying the foundation principle of federal aid.

Make the Plant Safe

SEWAGE-PLANT hazards are seldom emphasized in discussions on safety and receive but indifferent attention from those who are most vitally concerned. It it only when we hear of the unnecessary death of persons engaged in the operation or repair of a plant that we become momentarily cognizant of the numerous potential dangers that are everywhere apparent in a sewage-treatment works.

Toxic fumes are generated in abundance; explosive gases lurk in every tank and manhole; narrow walkways without guide rails invite accident. Such conditions constitute hazard enough, but when we consider that often only a single operator is on duty, without the remotest opportunity to call outside aid should an accident occur, we have a clearer picture of the risks involved.

The indictment of indifference falls not alone on the sewage works associations, who have failed properly to emphasize and acquaint their member constituencies with safety practices, but as well upon designing engineers, who almost uniformly fail to provide adequate safeguards as an integral and necessary part of their structures. As an example of what can be done, there is the provision made in a new Midwest plant, where an underground chamber built around sludge tanks cannot be entered until a switch is closed that starts an air-exhaust system. Schemes such as this could find useful application in dozens of sewage-disposal plants, yet they are seldom if ever used. The primary responsibility for safety provisions thus rests on the engineer. Beyond this lies the plant operator's personal obligation to insist on elimination of hazards and on observance of rigid safety-first practices in the day's work.

CURRENT NEWS

Bids To Be Called On Conchas Dam

Concrete and earth dam on South Canadian River to be used for irrigation and flood control

BIDS for the construction of Conchas Dam in New Mexico are to be ready for advertisement about June 15, according to Capt. Hans Kramer, district engineer at Tucumcari, N. M.

Dam 220 ft. high

Conchas Dam is to be located across the South Canadian River about 25 mi. north of Newkirk in the northeastern part of New Mexico. It will consist of a concrete gravity-section dam about 220 ft. high and 1,160 ft. long located in the river canyon, together with earth dikes on each side having an overall length of about 4 mi. The main dam will contain conduits for releasing water to maintain the low flow in the river and for drainage of the reservoir, also an overfall spillway 300 ft. long. About 700,000 cu. yd. of concrete will be required for this structure and the earth dikes will require 3,400,000 cu.yd. of material. Located in the north dike will be a concrete surfaced emergency spillway 3,000 ft. long to take care of large floods.

Large storage reservoir

The reservoir created by the completed dam will have a storage capacity of about 600,000 acre-ft., of which 100,000 acre-ft. will be dead storage, 300,000 acre-ft. irrigation storage and 200,000 acre-ft. flood control. The reservoir will extend up the South Canadian River valley about 14 mi. and up the Conchas River valley about 9 mi.

An irrigation outlet and a water supply outlet will be constructed through the dam for future use.

A 25-mi. construction road from Newkirk, N. M., to the construction camp is now open for use, topographic surveys of the reservoir area have been completed and about 20,000 ft. of cores have been drilled in the foundation investigation. A construction camp is being built and utility services are being installed. Excavation for the foundation of the main dam has been commenced.

The work is to be carried out under the direction of the Corps of Engineers, U. S. Army. It is being financed under the War Department appropriation bill of 1936.

Bridge Design Competition Goes to C. H. Rosa

First prize in the eighth annual bridge design competition held by the American Institute of Steel Construction was awarded to Clarence H. Rosa, a student of the University of Michigan. A. W. Millington, Rensselaer Polytechnic Institute, took second prize, and first honorable mention went to Russell E. Madsen, also of Rensselaer. Second and third honorable mentions went to John A. Grove and Frank R. Streba, respectively, both of Carnegie Institute of Technology. The problem was to design a steel highway bridge having a span of 300 ft. and a minimum vertical clearance of 30 ft.

Municipal Bankruptcy Act Declared Unconstitutional

The Municipal Bankruptcy Act of 1934 was declared unconstitutional by the Supreme Court in 5 to 4 decision on May 25 in a test suit brought by bond holders of the Cameron County, Tex., Water Improvement District No. 1. The law was condemned in majority opinion by Justice McReynolds as an infringement of a constitutional provision against impairment of contract obligations. Justices Hughes, Stone, Brandeis and Cardozo dissented.

Los Angeles Hotel Fixes Plumbing for A.W.W.A.

In accordance with A.W.W.A. practice, the Biltmore Hotel, Los Angeles, host to the American Water Works Association June 8 to 12, has been subjected to rigid plumbing inspection since the Association determined after the Chicago amoebic dysentery epidemic, in 1933, that it would not patronize a hostelry replete with dangerous cross connections, and subject to back siphonage of toilet fixtures. Inspection was started a year ago by the local committee which recently reported its recommendations had been complied with. Changes included the installation of 272 vacuum breakers on toilets in the two upper floors of this 13-story hotel, elimination of a swimming pool cross-connection and a direct drain connection from the house filters to a sewer 28 ft. above the filters, and finally abandonment of overhead sewers in the commissary.

The committee consisted of C. G. Gillespie, chief engineer, State Board of Health, R. F. Goudey and N. F. Sláne.

Cable Spinning Completed on Golden Gate Bridge

On May 20 spinning operations were completed on the two main cables 36½ in. in diameter on the Golden Gate Bridge at San Francisco. Since the addition of the third sheave to each spinning wheel assembly, thus conveying six wires instead of four, the work has progressed much more rapidly than formerly and completion was accomplished 26 days ahead of schedule. Work has already begun on the placement of equipment which will be used to compress the individual strands into the compact circular cables. The story of these new developments in cable spinning operation was published in *Engineering News-Record*, April 30, 1936, p. 617.

Interior Bill Deadlocked

Congressional deadlock threatens passage of Interior Department Bill carrying funds for completion of reclamation projects

Washington Correspondence

A DEADLOCK between House and Senate that had not been broken on May 25 threatens the major portion of the Reclamation Bureau's construction program. By a vote of 113 to 70 on May 20, the House refused to accept Senate amendments to the Interior Department Appropriation Bill (*ENR*, March 5, p. 364) authorizing seven projects on which construction has been undertaken with relief fund allotments, and appropriating $25,600,000 for the projects and $29,510,000 for ten projects previously authorized by Congress. On May 22 the House appointed a conference committee headed by Representative Taylor, of Colorado, with instructions to oppose the amendments to the bill that were passed by the Senate.

Part of the opposition lies in the objection of the House, as expressed by Representative Buchanan, chairman of the Appropriations Committee, to the usurpation of its prerogatives by the Senate by including legislative authorization and appropriations for projects not included in the bill as it passed the House. The reclamation projects were not included in the House bill because it was feared that they might be blocked. The late Elwood Mead, Commissioner of Reclamation, was very ill at the time, and those in charge of the legislation felt that the prospect for favorable consideration would be better if the program was submitted to the House after it had passed the Senate.

Weeks of haggling followed. The situation was further complicated by the illness of Representative Taylor, and on the date that this report was written, the fate of the bureau's construction program was still hanging in the balance. Secretary Ickes has pointed out that if the appropriation fails the government will be exposed to damages for any construction contracts that may be interrupted. The objection of the House also extends to an appropriation of $3,710,500 for irrigation projects on Indian reservations.

Rate-Making Policy For Federal Power Projects

Following several conferences participated in by all governmental agencies interested in electric power, senators from the Pacific Northwest introduced in Congress a bill with the dual purpose of providing for the operation of the Bonneville project, now under construction on the Columbia River, and of formulating a policy for the disposition of surplus power from other federally-owned plants.

As introduced by Senators McNary and Steiwer, of Oregon, and Bone and Schwel-

lenbach, of Washington, the bill places responsibility for completion and operation of the Bonneville plant on the Corps of Engineers, but vests the authority to set rates and to distribute surplus power in the Federal Power Commission. The latter is authorized to:

1. Determine rate charges for surplus power at all authorized federal projects.

2. With the consent of the purchaser, to revise the rates specified in any existing contract for power from a federal plant, except that at Boulder Dam the consent of the states of Arizona and Nevada must be obtained.

3. To regulate rates for federal power with due regard to: (a) insuring sufficient revenue to cover costs of maintenance, operation and amortization of costs chargeable to power development, transmission and sale; (b) marketing conditions; (c) consumer interest; (d) general public welfare.

After meeting the requirements of navigation, irrigation and other operating needs power is to be sold to state and local governments and to non-profit corporations "as nearly as possible at actual cost." Additional power after these demands are met may be sold to privately-owned utilities.

New rate bases

The authority of the Federal Power Commission over rates is limited to wholesale power sales for re-sale. Consumer rates are regulated by the individual states. It is specifically provided that in determining the wholesale rates the Federal Power Commission "shall not be controlled or guided by the rates, rate structure, or rate base of any privately owned utility company engaged in the business of selling or distributing electrical energy." Contracts will be made for not more than ten years, with the option of renewal for an additional ten-year period by the purchaser.

When necessary to reach a market, the Secretary of War is given authority to construct transmission lines, substations and other facilities, or to acquire such as are now in service by purchase, lease or condemnation.

Senator Pope, of Idaho, has announced that a group of senators will fight the passage of the bill. Their objection is based on the belief that rates for electricity from the Bonneville project would increase with the distance from the plant, thus discriminating against Idaho, Montana, and Northern California.

REA Projects in Virginia To Be Released

Strained relations between the Rural Electrification Administration and the Virginia State Corporation Commission have been adjusted as the result of a conference between members of the commission and Morris L. Cooke, REA Administrator, held May 18 in Richmond.

Although no formal agreement was formulated, REA is satisfied that its operations in Virginia can safely be resumed. The commission's order directing the Virginia Electric & Power Co. to serve some 30 customers in the Chancellor section of Spotsylvania County, previously included in the territory of Farmers Rural Utilities, Inc., will not be affected, and the rural utilities plans will be revised in accordance with the new conditions. Other pending projects in the state will now be released.

Flood Control

Omnibus flood control bill passed by the Senate and Mississippi River bill approved by the House

Washington Correspondence

FLOOD CONTROL took a leading place on Capitol Hill last week as the Senate passed a revised, but not enlarged, omnibus flood control bill and the House, not to be outdone, squeezed through by a close vote the Overton bill carrying on the control of the lower Mississippi River by floodways and reservoirs.

Each of the measures has already been passed by the other House, but both were substantially changed so that conference committees will be necessary to iron out the differences.

Most noteworthy of the two, not only because of its wider scope but also because it establishes a new principle, is the omnibus bill. It has had a checkered career. As passed by the House in July of last year, it was just another of a long line of bills authorizing $370,929,000 in rivers and harbors projects all over the country. The Senate, running wild, added more projects with reckless prodigality until the total was roughly $700,000,000, and Senator Tydings of Maryland, in a notable speech, ridiculed it back to the Commerce Committee for revision.

While the committee was struggling, record-breaking floods struck many of the eastern states, bringing a further deluge of new flood-control demands to be added to the already swollen measure. Then the committee cut the Gordian knot: it ruled out ruthlessly (1) all projects not directly connected with flood control; (2) all projects not favorably reported, either as having economic justification or involving the protection of human life, by the Board of Engineers for Rivers and Harbors.

Chairman Copeland of the committee carried these principles to the floor of the Senate, where he did a heroic job of fending off a flood of amendments from the floor. He was greatly aided by the inclusion in the bill of a new wrinkle: a provision for examination and surveys to be made on a host of unqualified projects. This made it possible to switch such proposals from the status of definite authorizations to that of suspension for further study. As a result, the army engineers have a list of surveys ahead of them which should last for twenty years.

Flood policy laid down

But the major accomplishment of the committee was the formulation, for the first time, of a definite federal policy toward flood control. As passed by the Senate, the bill recognizes that destructive floods are a menace to the national welfare; that flood control on navigable waters and their tributaries as well as their watershed areas is a proper function of the federal government in cooperation with the states and their local divisions; that the federal government should participate in improvement works when benefits exceed costs and when the lives and security of the people are endangered.

Continued is the traditional responsibility of the Corps of Engineers over navigable waters; added is a new provision placing the Soil Conservation Service of the Department of Agriculture in charge of waterflow retardation and soil erosion prevention on the watersheds. The committee recommended the creation of a new body, to be known as the National Resources Board, to act as a general staff in co-ordinating the work of the two departments, and as a policy-making body in the field of flood regulation. It would take over the work now being done by the National Resources Committee. The proposal, however, was too revolutionary to be accepted by the Senate on such short notice, and was referred to the Committee on Public Lands for further study.

Bitterest debate was over the financing of flood-control works. As reported and passed, the bill continues the traditional policy of requiring local governments to (a) provide the necessary lands and rights of way; (b) assume all damage claims; (c) maintain and operate after completion.

Mississippi flood control

Weighted down with prohibitive amendments, the Overton bill, intended to provide for the completion of the lower Mississippi River flood control project, was passed by the House of Representatives May 22 by a vote of 162 to 156. Before the final vote was taken reservoir advocates succeeded in adding an amendment providing for the construction of 26 reservoirs on the Arkansas and White rivers. Another amendment by Rep. Thomas A. Jenkins, of Ohio, requiring local interest to furnish all lands, easements and rights of way, also was adopted.

It is claimed by advocates of the bill that the reservoir amendment, which is not recommended by the Corps of Engineers, will result in a veto. The land payment amendment means that local interests in Louisiana will have to pay $13,000,000 to provide flowage rights for the three floodways provided for in the measure. It is expected that the two amendments will be eliminated by the conferees, but there is doubt as to whether or not the House will accept such a conference report.

Planning Board Organized for New York World's Fair

A board of architects and engineers has been appointed to prepare general building specifications for the 1939-40 New York World's Fair. Stephen F. Voorhees is chairman; the other members are Gilmore D. Clarke, William A. Delano, Jay Downer, Robert D. Kohn, Walter D. Teague, and Richmond H. Shreve. Eliel Saarinen, of Detroit, and Paul Cret, of Philadelphia, have been asked to act as consultants to the board. The board will establish the architectural characteristics of the fair, set up height and area limitations, and fix standards for, and types of, buildings to be constructed by the fair corporation and by the concessionaires.

Outside architects will be asked to submit designs for all buildings erected by the corporation. Members of the board will not enter the competition. Board members, however, will be permitted to design buildings for the concessionaires.

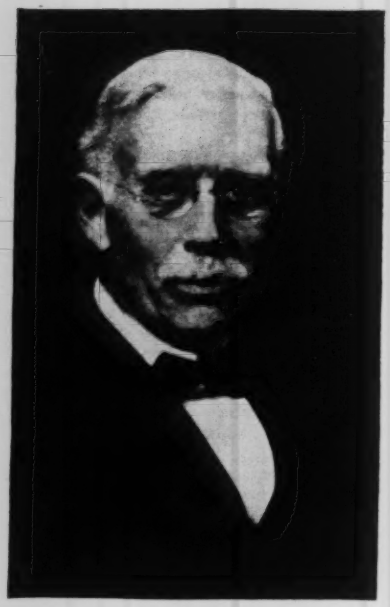
The board expects to complete the general plans by Sept. 1.

W. Earle Andrews, superintendent of the New York City Park Dept., has been appointed general manager of the fair.

Samuel Austin Dies; Head of Building Firm

Samuel Austin, founder and chairman of the board of the Austin Co., industrial engineers and builders of Cleveland, Ohio, died May 23, at his home in Willoughby, O. He was 85 years old.

Mr. Austin was born in England and served his carpenter's apprenticeship there. In 1872 he came to this country intending to go to Chicago where reconstruction had just been begun following the great fire. However, Mr. Austin stopped off at Cleveland and decided to locate there. Ultimately



Samuel Austin

he got into industrial building construction and about 46 years ago established the Austin Co. In 1895 the company undertook its first out-of-town job, a factory for the Mineral Wool Co. at Chicago. Since that time its business has expanded to include the construction of more than 5,000 industrial plants, the most recent large one being that of the Electro-Motive Corp. at Chicago. In 1929 the company entered into a contract with the Russian Soviet government for the construction of its automobile plant and industrial community at Gorki.

Wilbert J. Austin, son of Samuel Austin, some years ago succeeded his father in the active direction of the Austin Co.

Connecticut Reports Lack of Skilled Equipment Operators

An acute shortage of experienced operators of road building machines in Connecticut has been reported by state highway commissioner John A. Macdonald. An investigation of the report, made by Leonard J. Maloney, assistant director of the federal and state employment service, Hartford, shows that there are practically no available registered operators of road building equipment. Contractors, who are hampered in road building contracts by the lack of men qualified to operate steam shovels, bulldozers and road graders, have asked for a longer work week.

N. Y. State Society Begins Tenth Year

Professional group gathered in New York for one-day session — Continued growth of society recorded

PROFESSIONAL activities of the engineers of New York State were the subject of discussion at the ninth annual meeting of the New York State Society of Professional Engineers held in New York City on May 23. Business sessions were conducted both morning and afternoon; at a luncheon meeting the three principal speakers took as their subjects the work of the U. S. Soil Conservation Service, engineers in relief operations in New York City, and state legislation of interest to engineers.

Legislation affecting engineers

Membership in the society has grown to 3,095, according to the financial secretary, E. F. Fox, and the society's financial condition has improved greatly since the end of 1934, there being about $4,000 in the treasury, as against $800 at the end of 1934.

Arnold G. Chapman, Albany, reported on the work of the legislative committee, reviewing action taken on legislation of special interest to engineers. During the legislative session engineers joined with architects in an effort to amend their respective license laws to reduce the size and cost of structures whose construction is exempt from the provisions of those acts. The present high exemptions ($10,000 and 30,000 cu. ft.) were forced into the laws by real estate interests at the time of their passage. The amendments proposed this year did not pass but will be submitted again next year. They cut the exemptions to $5,000 and 10,000 cu. ft.

Mr. Chapman also reported on the committee's work in opposing the passage of laws containing provisions detrimental to the interests of engineers and stated that the committee had been quite successful in stopping the passage of such acts or in having them modified to eliminate the objectionable provisions.

Bills providing for county government reorganization were submitted to the legislature, including one by Senator Thomas C. Desmond, a member of the society. The bill finally passed was less specific than the Desmond bill in the matter of engineering positions and Mr. Chapman emphasized the fact that it would be up to the county chapters of the society to see that these deficiencies were corrected in setting up the reorganized county government under the new law.

Senator Desmond, in his talk at the luncheon meeting, spoke of the "Public Projects Efficiency Bill" which he had introduced into the legislature without obtaining its passage. It would require independent engineering advice on all projects of an engineering nature put up to the public bodies of the state for approval. Senator Desmond pointed out how impossible it is for the legislature, for example, to act intelligently upon matters of an engineering nature.

D. B. Steinman, chairman of the committee on ethics and a member of the engineer license board, reported on violations of the license law and stated that it was the policy of the Department of Education to avoid court action wherever possible. This policy has resulted in the elimination of many violations without difficulty. One case taken to court by the Department of Education was against a company that was installing an irrigation system for golf courses without having the engineering work done by a licensed engineer. The case was not a clear-cut one and finally was dismissed without an opinion from the court.

Dr. Steinman stated that the license board is swamped with applications for registration, there being now over 1,000 for the June examination. This is due in part to the fact that after January 1, 1937, all applicants must take a two-day examination, but Dr. Steinman stated also that it is due to the amendment to the license law passed last year making it illegal for a corporation to practice engineering unless its principal officers are licensed. About 2,000 of the present applications are from men in the electrical industry. There now are 10,000 registered engineers in New York State.

Change of headquarters

At the winter meeting special committees were appointed to look into the matter of moving the headquarters of the society from New York to Albany, to consider whether the dues of the society should be reduced, and to recommend revisions of the constitution. The headquarters committee reported to this meeting as in favor of moving the headquarters to Albany. Establishment of an auxiliary headquarters at New York, where nearly half the members of the society reside, will be taken up later by the board of directors if the society votes to transfer headquarters to Albany with a full-time secretary. No change was recommended in the dues. Proposed changes in the constitution will be considered at the Syracuse meeting this summer.

Relief operations

The society went on record as favoring doing the greatest possible amount of federal construction work by the normal federal agencies rather than as relief operations, also as favoring the continuation of PWA financing of non-federal public works.

The society adopted a resolution calling on the federal government to set up a central agency for each drainage basin to correlate water use and plan for flood control, the federal government to provide funds immediately for surveys and flood control plans.

At the luncheon meeting, H. H. Bennett, chief of the Soils Conservation Service, spoke on the relation of the Soils Conservation Service work to flood control, and Victor F. Ridder, retiring head of the relief operations in New York City, told of some of the difficulties of the Works Progress Administration in carrying on construction work with men untrained for such work and unfamiliar with it. Mr. Ridder expressed himself as heartily in sympathy with the efforts made by representatives of the New York State Society of Professional Engineers and the Metropolitan Section, American Society of Civil Engineers, to improve the standing of engineers in the relief operations and to have the men occupying engineering positions licensed engineers. He also expressed

hearty disapproval of the agitation stirred up by other groups claiming to represent the engineering profession.

Mr. Ridder complimented his engineering assistants in the relief work and stated that it was his opinion that his successor should be an engineer.

New officers

The following officers were re-elected for the year 1936-37: President, John C. Riedel; vice president, Alfred E. Roche and F. H. Zurmuhlen; financial secretary, Ernest F. Fox; and treasurer, Patrick M. Corry. The following directors were elected: LeRoy J. Cali, George W. Codwise, Oscar A. D'Luhosch, Andrew K. Johnson, Francis J. Laverty, Werner C. Strecker, Howard S. Thomas and Harold R. Towse.

Washington Highlights

By Paul Wooton

The District of Columbia Supreme Court on May 21 granted to the New York State Electric and Gas Co., a temporary restraining order preventing Administrator Ickes of PWA from alloting $520,000 to the city of Plattsburg, N. Y., for the construction of a municipal generating plant and distribution system. The company maintains that it was already providing service and that the community is too small to support two competing electric systems.

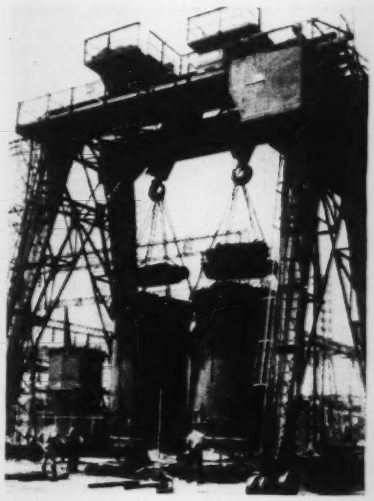
Revival of the Walsh-Healey measures for the control of wage and hour provisions on government contract work, with a bare possibility of passage before final adjournment of Congress, is seen as the result of a surprise agreement of the House Judiciary Committee to reconsider the general subject. The bill had previously been tabled by the committee and was believed to be dead.

President Roosevelt signed the Norris Bill on May 20. The bill, in effect, perpetuates the existing Rural Electrification Administration set-up. Rural electrification will be assisted by low-interest loans; $410,000,000 is to be used over a ten-year period. Loans may be made to private utilities, but preference must be given to municipal, cooperative, non-profit, and limited dividend corporations. All loans must be self-liquidating, those for transmission or generating equipment within 25 years, those for house-wiring and appliances within five years. Beginning July 1, funds will be provided by the Reconstruction Finance Corporation up to $50,000,000 the first year. Thereafter Congress is authorized to appropriate $40,000,000 a year for the next nine years.

If present plans of the public works bloc materialize, the relief bill as reported from the Senate Appropriations Committee will include a provision increasing PWA'S revolving fund from $250,000,000 to $400,000,000, available for grants as well as loans on new projects. Senator Adams, subcommittee chairman, proposed a reduction in the grant from 45 per cent to 30 per cent of project cost but apparently is willing to let it stand at the present figure in view of the fact that many local referenda on project bond issues assumed that the grant would be 45 per cent. It is doubtful, according to Administrator Ickes, whether PWA will open application lists to more projects in view of the large number now pending.

Supreme Court Checks Arizona In Colorado River Suit

The U. S. Supreme Court, on May 25, refused to permit the State of Arizona to file an original suit for determination of its rights to Colorado River water. This decision was based principally upon Arizona's failure to name the United States as co-defendant with the states party to the Colorado River Compact. As the United States cannot be sued without its consent; Arizona's only recourse now seems to be to obtain enactment of a bill consenting to the suit.



GANTRY CRANE FOR BOULDER DAM

Acceptance tests of what is said to be the largest gantry crane in service in Southern California have been successfully completed by the Los Angeles Bureau of Power and Light. The crane will be used to lift the 185-ton transformers to be installed by the Bureau of Power and Light at its receiving station for Boulder Dam power.

In the acceptance tests, two large transformers and steel ingots were used to equal the 185-ton weight of a single transformer. Mounted on wheels and propelled by an electric motor, the crane travels on a runway 172 ft. long. It is 53 ft. high and has a lift of 40 ft. Two motors operate the lifting hooks. Much of the electrical equipment being installed in the sub-station where Boulder Dam power will be received in Los Angeles is the largest ever used, making necessary special preparations for handling the heavy units.

A.W.W.A. Organization Changes Outlined by Jordan

Organizational changes initiated by the American Water Works Association to provide more effective administration of the association's affairs to meet growing needs, announced by H. E. Jordan, chairman of the General Policy Committee, will include an extension of the secretary's duties and the appointment of two assistants. Beekman C. Little, secretary for the past ten years, retired on May 1, becoming secretary emeritus. Percy S. Wilson has been appointed acting secretary. A. V. Ruggles, assistant to the secretary also retired from the staff on May 1.

The policy committee appointed last year by the Board of Directors of the A.W.W.A. recommended in its report made in January, 1936, that progress in future development depended on (1) well-planned membership expansion, (2) the organization of more sections within single state boundaries, (3) better contact with other organizations interested in municipal administrative practice, and (4) a definite program directed toward improving the status of waterworks personnel.

To make these, as well as other correlative aims effective, the committee reported that it was, "fully convinced that for the future good and progress of the association, a redefinition of administrative functions is imperative and that incidental thereto certain changes in personnel may be required. Emphasis needs to be made and activities undertaken, both of which demand more active direction than our staff now receives."

In the plan of reorganization it was recommended that the secretary be made the continuous active administrative head of the association to give full time to the planning and execution of all activities including the direction of the waterworks practice committees.

SOCIETY CALENDAR

MIDWEST WELDING CONFERENCE, Chicago, Ill., June 4-6.

AMERICAN WATER WORKS ASSOCIATION, annual meeting, Los Angeles, Calif., June 8-12.

INSTITUTE OF GOVERNMENT, eighth annual conference, Los Angeles, Calif., June 15-19.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, semi-annual meeting, Dallas, Tex., June 15-20.

INTERNATIONAL CONFERENCE ON SOIL MECHANICS AND FOUNDATION ENGINEERING, Cambridge, Mass., June 22-26, 1936.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, annual meeting, Madison, Wis., June 23-26.

HIGHWAY SAFETY CONFERENCE, Ames, Iowa, June 29-July 2.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, N. J., June 29 to July 3.

NEW YORK STATE ASSOCIATION OF CITY AND VILLAGE ENGINEERS, spring meeting, Kingston, June 3-5.

ILLINOIS ASSOCIATION OF SANITARY DISTRICTS, annual meeting, Urbana, Ill., June 11-12.

NEW YORK STATE SEWAGE WORKS ASSOCIATION, spring meeting, Long Beach, Long Island, June 11-13.

PENNSYLVANIA SEWAGE WORKS ASSOCIATION, annual conference, State College, Pa., June 24-26.

NEW ENGLAND WATER WORKS ASSOCIATION, annual outing, North Scituate Beach, Mass., June 25.

THE METROPOLITAN SECTION (New York), AMERICAN SOCIETY OF CIVIL ENGINEERS, at its annual meeting held May 20, elected Leslie G. Holleran, president; Harry D. Winsor, vice-president; and E. P. Goodrich, George W. Burpee and Victor Gelineau, directors. William J. Shea was re-elected secretary. Society affairs were made the subject for discussion at the meeting. George T. Seabury, secretary, told what the society has done for engineers during the past few years and how it has aided in the development of employment opportunities for engineers, and Ernest P. Goodrich told what the society has done in its work to improve salary conditions among engineers. Following the business meeting, the junior branch of the section held its annual effective speaking contest.

EXAMINATIONS for registration as Engineers, Land Surveyors and Architects will be held as follows:

MICHIGAN—Examinations for Engineers and Land Surveyors at University of Michigan, Michigan State College, Michigan College of Mines, and at Ironwood; for Architects, at University of Michigan, June 18-20.

Obituary

LAWRENCE J. FELL, 55 years old, well known member of the engineering division of the city of Buffalo, N. Y., for the last 25 years, died May 24 at his home in that city.

EDWARD D. STRICKLAND, executive secretary of the Engineering Society of Buffalo, N. Y., died May 14, after a sudden illness. He had been secretary of the society since 1930.

PERRY LAWTON, for many years a civil engineer in private practice at Quincy, Mass., died in that city on May 19 after a long illness. He was born in Quincy 68 years ago and was educated at Harvard University.

STEPHEN ELBRIDGE COOMBS, retired civil and construction engineer, Yonkers, N. Y., died in New York City on May 22 at the age of 70. Mr. Coombs was graduated from Massachusetts Institute of Technology in 1887 and became associated with Col. George Waring, Jr., New York. In 1887 Mr. Coombs became assistant engineer of the Toledo & Kansas City R.R. In 1890 he went with the Burlington line and became principal assistant engineer for more than five years. He later became chief engineer of the Southern Missouri & Arkansas and Cape Guordeny and Northern R.R., and in this capacity located and built many miles of new lines. Mr. Coombs became associated with the New York Central R.R. as chief draftsman in 1903 and in 1905 was made assistant engineer five years later becoming assistant to the construction engineer. He later became assistant to the valuation engineer and then special engineer to the chief engineer in 1916, and in 1926 became special engineer at New York for the land and tax department of the road.

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards total $35,466,000 for the 4-day week. (Early closing account May 30.) This short week total is made up of private, $12,662,000; public, $22,804,000; federal, $4,701,000; state and municipal, $18,103,000. Corresponding values a year ago are: total, $31,047,000; private, $18,711,000; public, $12,336,000; federal, $3,032,000; state and municipal, $9,304,000.

Waterworks and commercial buildings made substantial gains this week. The volume by classes of work is: waterworks, $4,663,000; commercial buildings, $8,375,000; industrial buildings, $3,977,000; public buildings, $6,106,000; highways, $4,552,000; bridges, $3,132,000; sewerage, $1,505,000; earthwork, drainage, $1,248,000; unclassified, $1,908,000.

The larger projects include: improvements cement plant for Universal Atlas Portland Cement Co., day labor, Birmingham, Ala., $1,500,000; cold reduction mill and skin pass mill (tin plate) for Youngstown Sheet & Tube Co., Indiana Harbor, Ind., $1,300,000; office building for Rockefeller Center, Inc., New York, N. Y., $3,500,000; theater, garage, etc., for Patterson Estate, Palm Springs, Calif., $1,500,000; state tuberculosis hospital, Orlando, Fla., $515,000; superstructure Soldiers Memorial Building, St. Louis, Mo.; $548,000; metal library bookstacks, filing equipment, etc. for Archives Building, Washington, D. C., $1,386,000; repairing streets and sidewalks, day labor, Johnstown, Pa., $598,000; highways, by Missouri, $526,000; bridges, by New York, $523,000; grade separation Livernois Ave. and Michigan Central R.R., Detroit, Mich., $410,000; Ralston Creek Dam, outlet and spillway works, Denver, Colo., $1,041,000; motors for pumping plants for Metropolitan Water District, Los Angeles, Calif., $1,767,000; South Mountain reservoirs, Allentown, Pa., $982,000; portion sewer projects in Erie Canal, Buffalo Sewer Authority, Buffalo, N. Y., $738,000; activated sludge type sewage disposal plant, Belleville, Ill., $457,000; steel inner liner in Fort Peck Power Tunnel, Fort Peck, Mont., $910,000; signalling equipment, Board of Transportation, New York, N. Y., $681,000.

State and municipal bond sales reached the highest volume reported since December, $32,711,000, which includes $10,000,000 in Colorado state highway revenue warrants. This is part of a $25,000,000 issue reported earlier in the year as application for an RFC loan. The RFC loan was not consummated, however, and this is the first private sale under the proposed $25,000,000 issue. This week's total also includes a transfer from PWA to private investment financing through sale by RFC of PWA bonds.

CONTRACTS
(Thousands of Dollars)

	Weekly Average May 1935	Prev. 4 Weeks	Week May 28, 1936
Federal Government	$4,057	$2,261	$4,701
State and Municipal	12,172	24,635	18,103
Total public	$16,229	$26,896	$22,804
Total private	8,336	9,008	12,662
Week's total	$24,565	$35,904	$35,466
Cumulative to date:			
1935...$547,110,000	1936...$937,458,000		

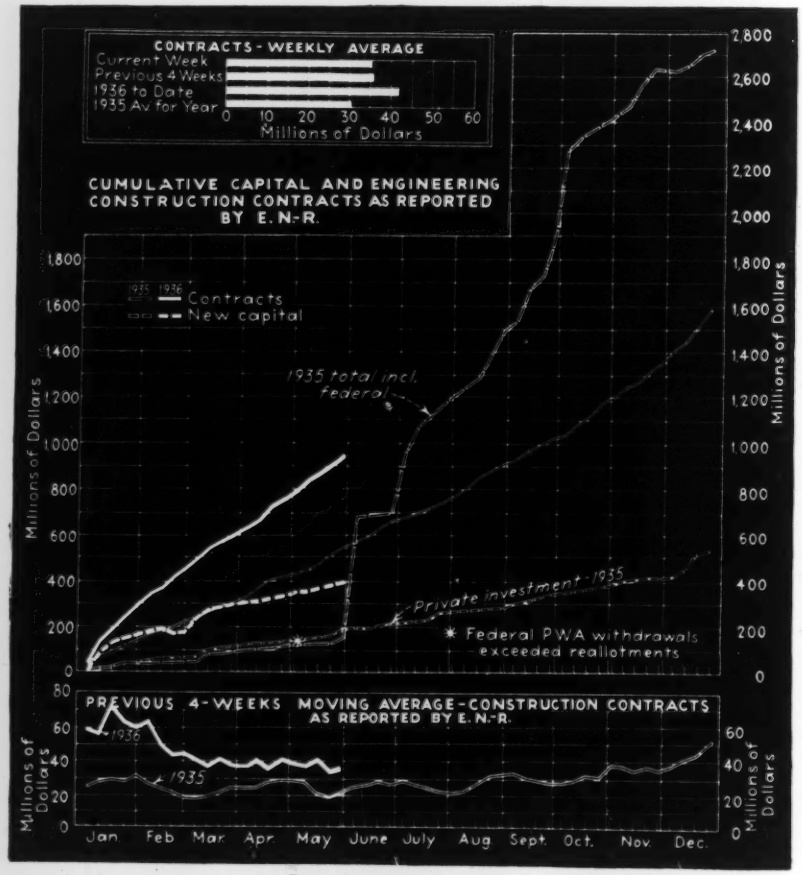
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1936	Week May 28	Cumulative
State and municipal	$32,711	$239,203
PWA non-federal	4,364	36,183
RFC loans	....	12,008
Corporate issues	1,117	103,813
PWA loans, Private	....	1,270
Total Non-Federal	$29,464	$392,477
Federal	....	4,955
Total new capital	$29,464	$397,432
Cumulative to date:		
1935...$142,322,000	1936...$397,432,000	

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for federal construction, deficiency act funds. An arbitrary percentage (25%) of the WPA allotments and local contributions to WPA work is included to allow for the capital additions through the Works Progress Administration division of the new program.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
May, 1936	**203.40**	**97.77**	**Apr., 1936**	**166**	**73**
Apr., 1936	202.20	96.71	Mar., 1936	160	70
May, 1935	194.06	93.28	Apr., 1935	130	57
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1936 to Date
1935 Av for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1935 1936
Contracts
New capital
1935 total incl. federal
Private investment 1935
* Federal PWA withdrawals exceeded reallotments
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1936
1935
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

CONSTRUCTION REPORTS

WATERWORKS

PROPOSED WORK

Calif., San Francisco—State Hy. Comn., Sacramento, cancelled bids to have been opened May 13, for water system, planting various types of trees and shrubs, grading, planting, lawn, etc., at 5th St. Plaza in connection with San Francisco-Oakland Bay Bridge, involving 460 ft. 14 in., 635 ft. 1 in. and 650 ft. 3 in. galvanized iron pipe, sprinklers, heads, etc. Will revise specifications and readvertise. Noted Apr. 28, C. D.—Apr. 30, E. N.-R.

Ill. St. David—City plans constructing water supply and distribution system, $63,000. P.W.A. project. Wood, Walraven & Tilley, 322½ South 6th St., Springfield, engrs.

Ia., Eagle Grove—City voted $39,000 bonds, constructing waterworks system.

Me., Bangor—City, J. G. Wallace, city mgr., D. P. Johnson, supt. Water Dpt., City Hall, plans nearing completion rein.-con. flume. Est. about $130,000. P. L. Bean, 145 Davis Ave., Auburn, engr. Noted Mar. 6, C.D.—Mar. 12, E.N.-R.

N. D., Rugby—City, H. Albertson, aud., plans watermain extensions in West 2nd and East 3rd Sts.

Pa., Kingston Twp. (Ind. Br. Wilkes-Barre)—Hillcrest Water Co., c/o N. Chrisman, Wilkes-Barre, plans water supply and distribution system in Mount Airey Terrace, Kingston Twp., Luzerne Co. Private plans.

Va., Keysville—City soon takes bids municipal waterworks system for town, completion of work on deep wells and chlorinating plant.

Que., Quebec—Municipality, J. A. Tremblay, engr., votes $5,000 for water works improvements.

BIDS ASKED

Calif., Santa Barbara—C. Hasse, city purch. agt., City Hall, taking bids materials and equipment for filtration plant, Sheffield Reservoir, incl. boiler tubing and c.i. pipe $300; sludge pumps $1,000; clarifier mechanism, and flocculator mechanism $18,300; underdrain manifold and wrought iron nipples $1,600; pumping equipment $3,400, for city. Noted Apr. 27, C. D.—Apr. 30, E. N.-R.

Ga., Sylvania—June 8, by City, constructing pump and pump house, etc. $20,000. P.W.A. project. R. L. Bell, Sylvania, engr.

Ill., Springfield—June 1, by City, Water, Light & Power, City Hall, Springfield, constructing piping, insulation and equipment, in connection with hot water heating and air conditioning system. P.W.A. project. C. H. Spaulding, genl. supt.

Ky., Louisville—June 23, by Louisville Water Co., removing and resetting two 400 hp. steam boilers and appurtenances; additions to steam piping and condensate system; with appurtenances; traveling intake screens, completely installed; short plate girder rein.-con. bridge and tunnel and appurtenances to accommodate certain pipes. J. Chambers, ch. engr. and supt.

CONTRACTS AWARDED

Calif., Sacramento—City Council, constructing water storage reservoir at filtration plant, involving 17,000 cu.yd. earthwork, to Campbell Constr. Co., 800 R St., $142,444. Est. $140,000. P.W.A. Bids Apr. 23, awarded May 13. Noted May 1, C. D.—Apr. 9, E. N.-R.

Calif., San Bernardino—Bd. Water Comrs., furnishing turbine pump to have 405 g.p.m. capacity, 1,160 r.p.m., 230 ft. head direct connected to a 440 volt, 40 hp. motor, to Pomona Pump Co., 406 South Main St., Los Angeles, $1,974; booster pump, 450 g.p.m., 150 ft. head, direct-connected to 440 volt, 3 phase, ball bearing, horizontal motor, 25 hp., to De Laval Steam Turbine Co., 1055 South Olive St., Los Angeles, $481. Bids May 4, awarded May 11. Noted Apr. 29, C. D.

★ **Colo., Denver**—Bd. Water Comrs., City and County Bldg., constructing Ralston Creek Dam, Outlet Works and Spillway, to United Constr. Co., Winona, Minn., $1,041,252. P.W.A. Bids May 12, awarded May 16. Noted May 14, C. D.—May 21, E. N.-R.

Ill., Midlothian—Village, constructing waterworks and distribution system, to H. P. Reger & Co., 1501 East 72nd Pl., Chicago, $33,866. Est. $40,000. P.W.A. Bids Nov. 1. Noted Oct. 22, C. D.—Oct. 24, E. N.-R.

Mass., Harwich—C. Reppucci & Co., general contractors, 10 Garden Court St., Boston, 1,600 tons c.i. pipe in connection with waterworks construction to U. S. Pipe & Fdry. Co., Burlington, N. J., for Town, Bd. Selectmen, Town Hall. Noted May 14, C.D.—May 21, E.N.-R., under "Contracts Awarded."

Mass., Mansfield—Town, H. E. Everett, mgr., Town Hall, 800 tons c.i. pipe, to Warren Pipe & Fdry. Co. of Mass., 75 Federal St., Boston. Est. about $33,500. Noted Mar. 30, C.D.—Apr. 2, E.N.-R., under "Contracts Awarded."

Mich., Highland Park—City, furnishing, installing equipment in filtration plant building for city waterworks, to Roberts Filter Co., Darby, Pa., $13,085. P.W.A. Noted Apr. 13, C. D.—Apr. 16, E. N.-R.

N. Y., St. George—Dpt. Water Supply, Gas & Electricity, Municipal Bldg., New York, heating system for Grant City Pumping Station, to E. Kiss, 207 East 43rd St., New York, $3,121; plumbing, to R. W. Baylor, 9 Sommers Lane, Port Richmand, $1,537. Bids Apr. 27. Noted Apr. 27, C. D.

★ **Pa., Allentown**—M. W. Gross, mayor, constructing South Mountain reservoirs (Lehigh Mountain, having 30,000,000 m.g.c., etc., to M. A. Long & Co., Commonwealth Bldg., $979,499; electrical wiring, to H. N. Crowder Co., 446 Union St., $2,422. Bids May 19. P.W.A. Noted May 11, C. D.—May 14, E. N.-R.

Wyo., Sheridan—City, furnishing labor, tools, transportation for settling basin, to B. Dean, Sheridan, $64,746***installing 13 mi. c.i. and steel pipe, to Olson Mfg. Co., 214 South 5th St., Boise, Idaho***rein.-con. reservoirs, to J. E. Crum, Casper***installing 36,000 lin.ft. c.i. pipe in distribution system, reconstructing present flow line, to Barnett & Record, 700 Flour St., Minneapolis, Minn.***cast iron pipe, to U. S. Pipe & Fdry. Co., Nebb Crawford Bldg., Birmingham, Ala.***steel pipe, to Western Pipe & Steel Co., 444 Market St., San Francisco, Calif.***valves, hydrants, fittings, to Hendrie & Bolthoff Mfg. Co., 1639 17th St., Denver, Colo.***vitrified pipe, to Denver Sewer Pipe & Clay Co., Bway. and Curtis St., Denver, Colo. ***irrigation type-gates and miscellaneous items, to Hardesty Mfg. Co., Box 2170, Denver, Colo. Total est. $600,000. Bids Apr. 22. P.W.A. Withdrew bids to have been opened Apr. 22, for diversion dam, to be readvertised. Noted Apr. 20, C. D.

SEWERAGE AND WASTE DISPOSAL

PROPOSED WORK

Ill., Girard—City made plans complete 8 and 10 in. sanitary sewers. $111,000. P.W.A. project. Wood, Walraven & Tilley, 322½ South 6th St., Springfield, engrs. Noted Aug. 6, E. N.-R.

Mich., Detroit—Dpt. P. Wks. plans repairing, concrete, concrete segmental block, Pleasant Ave. Sewer from Oakwood to Fort St., incl. manholes. $35,000. Council appropriated money. J. S. Stringham, City Hall, engr.

Minn., Faribault—City defeated $122,000 bonds for sewage disposal plant. Noted Apr. 23, C. D.—Apr. 30, E. N.-R.

†**Mo., Clarksville**—U. S. Eng., Custom House, St. Louis, soon takes bids constructing rein.-con. main lock and upper gateway on auxiliary lock, all on rock foundation; chamber of main lock to be 110x600 ft., length of upper guide wall 518 ft. and lower guide wall 503 ft., etc. in Mississippi River, here.

N. Y., Yonkers—City plans sewers in Halley St., Mile Square Rd., Halladay Ave. and Tibbets Valley. To exceed $23,000. C. Sheridan, city engr.

Pa., Duboistown—Boro plans sanitary sewerage system. To exceed $23,000. R. Brown, pres. Borough Council. M. C. Krause, County Bldg., Williamsport, engr. Noted May 16, C. D.—May 23, E. N.-R.

Sask., Weyburn—City, J. I. Strong, engr., preparing plans digester unit at sewage disposal plant. $18,000.

BIDS ASKED

†**Florida**—June 16, by U. S. Eng., Jacksonville, constructing 15.75 mi. levee, North Shore, Lake Okeechobee, incl. 7,000,000 cu.yd. unclassified material, dredging 1.5 mi. floodway channel, incl. removing 600,000 cu.yd. unclassified material.

†**Florida**—June 22, by U. S. Eng., Mobile, Ala., dredging 10,017,000 cu.yd. material in Sect. A, and/or 9,955,000 cu.yd. in Sect. B, incl. overdepth from waterway from Choctawhatchee Bay to West Bay.

†**Illinois**—U. S. Eng., U. S. Post Office, Chicago, bids about June 15, dredging 3,500,000 cu.yd. in Alton Pool; 7,900,000 cu.yd. in La Grange Pool; and 600,000 cu.yd. common and 418,000 cu.yd. rock excav. in Peoria Pool.

Md., Frederick—June 4, by Mayor and Bd. Aldermen, City Hall, 59,250 ft. 8- to 15-in. sewers, 44,225 lin.ft. house connections. P.W.A. project. Whitman, Requardt & Smith, West Biddle and Charles Sts., Baltimore, engrs.

Mich., Muskegon—June 4, by City Clerk, constructing sewage treatment plant. $150,000. Consoer, Townsend & Quinlan, 205 Wacker Dr., Chicago, Ill., engrs. P.W.A. project. Bids June 4 rejected. Noted May 18, C. D.—Apr. 9, E. N.-R.

N. Y., Buffalo—June 23, by Buffalo Sewer Authority, City Hall, constructing Div. Ka-Exchange St. alternate, incl. 9,340 lin.ft. 11 ft. semi-elliptical monolithic concrete sewer in old Erie Canal, Evans, Exchange, Larken and Scott Sts. and Upper Terrace, Div. Kb-Hamburg, drain alternate, 9,180 lin.ft. 11 ft. semi-elliptical sewer in Old Erie Canal, on New York Central R.R. and Lehigh Valley R.R. property, Scott St. and other right-of-way; Div. L-Perry-Elk Section, 5,413 lin.ft. 11 ft. semi-elliptical sewer in Van Rensselaer, Perry, Orlando and Elk Sts., Div. M-South Buffalo Sect., 500 lin. ft. 78 in., 9,650 lin.ft. 42 in. and 1,430 lin.ft. 24 in. diam. circular sewer in Bailey Ave. Abbott, and Mineral Springs Rds., Cazenovia Bldg., Stevenson St., etc. D. H. McCarriagher, chn.; adv. E. N.-R. May 28.

N. Y., Marcy—June 24, by Dpt. Mental Hygiene, State Office Bldg., Albany, constructing sewage disposal plant and water supply system at Marcy State Hospital. $156,300. Noted Feb. 21, C. D.—Feb. 27, E. N.-R.

N. Y., Orangeburg—June 17 (extended date), by Dpt. Mental Hygiene, State Office Bldg., Albany, constructing sewage disposal plant, Contr. 2, Rockland State Hospital. $151,796. Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

Pa., Mt. Penn—June 2, by Borough Council, G. H. Seitz, secy., constructing Sect. D, municipal disposal plant. P.W.A. project. Bids May 6 rejected. W. H. Dechant & Sons, 632 Washington St., Reading, engrs. Noted Apr. 23, C. D.—Apr. 30, E. N.-R.

LOW BIDDERS

★ **N. Y., New York**—Dpt. Sanitation, 125 Worth St., New York, May 20, superstructure for Manhattan Grit Chamber Contr. 13 and Bronx Grit Chamber, Contr. 14, of Wards Island Treatment Works, Contr. 13, from Rosoff Bros., 295 Madison Ave., $292,725 and $290,825 respectively***heating and ventilating for Manhattan Grit Chamber, Contr. 15 and for Bronx Grit Chamber, Contr. 16, from Dierks Heating Co., 210 East 31st St., New York, $23,595 and $21,400 respectively***plumbing for Manhattan Grit Chamber, Contr. 17, and Bronx Grit Chamber, Contr. 18, from J. L. Murphy, Inc., 340 East 44th St., $9,420 and $8,290 respectively. Noted May 11, C. D.—May 14, E. N.-R.

CONTRACTS AWARDED

Calif., Monterey Park—City Clerk, constructing pumping plant, complete intake and discharge lines for sanitary sewer, to Case Constr. Co., 905 Westminster Ave., Alhambra, $28,139. Est. exceeds $23,000. P.W.A. Bids May 4, awarded May 9. Noted May 14, C. D.

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E.N.-R. Engineering News-Record

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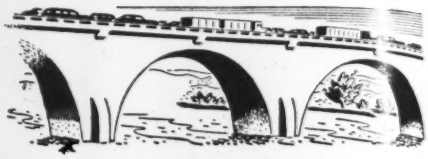

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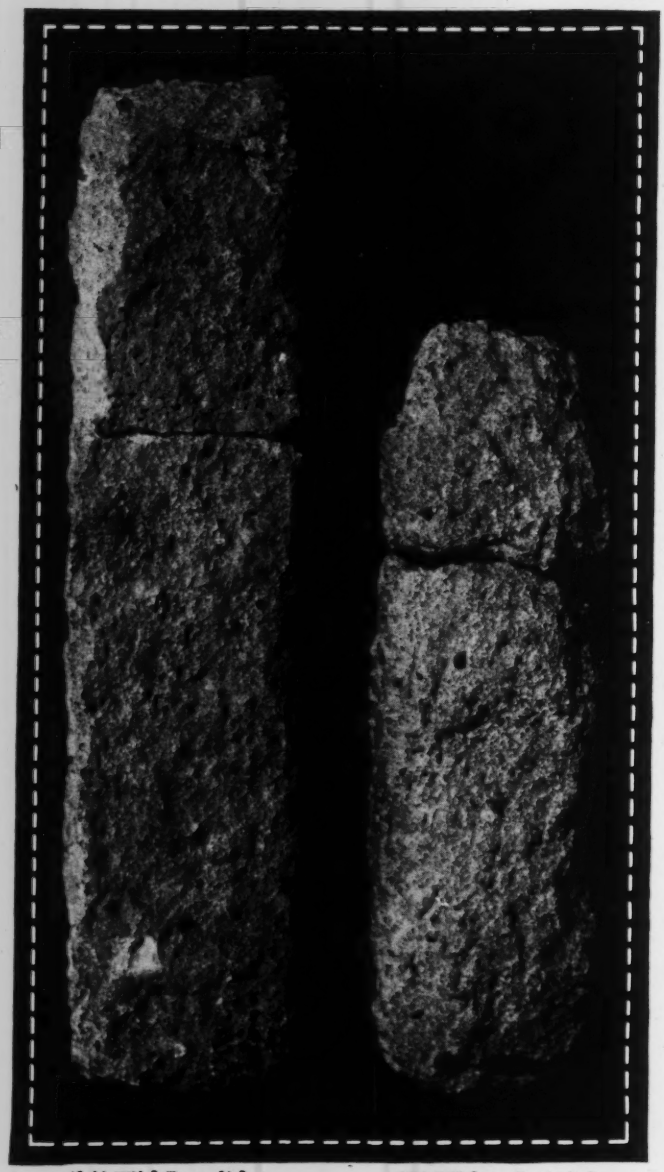

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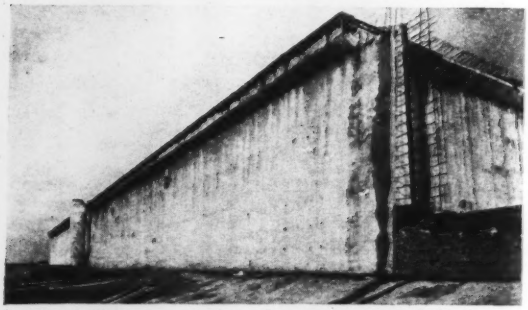

POZZOLITH was used in the construction of the City of Cleveland Water Reservoir, Parma, Ohio, The Hunkin-Conkey Company, Contractors.

MASTER BUILDERS

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sewerage, etc. (Continued)

Conn., Hartford — Metropolitan Dist., Contr. A, constructing 3,200 ft. 21 and 30 in. sanitary trunk sewer, incl. 1,500 cu.yd. rock excav. in Victoria Rd., Folly Brook Trunk Sewer, Wethersfield, to A. Liambo, Box 939, Waterbury, $50,816. Est. $147,000. **P.W.A.** Lowest bidder disqualified, failed to furnish proper financial statement. Bids Apr. 21. Noted Apr. 28, C. D.—Jan. 23, E. N.-R.

Conn., Norwich—State, general contract sewage disposal plant at Uncas-on-the-Thames Sanatorium, to F. Onuparik, Uncasville, Norwich, $25,209. Est. $42,000. Chandler & Palmer, Thayer Bldg., engrs. Noted Jan. 17, C. D.—Jan. 2, E. N.-R.

Ill., Belleville — City, constructing activated sludge type sewage disposal plant, complete with auxiliary equipment, appurtenances, extending present intercepting sewer about 500 ft. to connect with new plant, new outlet branch in Douglas St., new force main and lift station at 88th St. and new outfall sewer into Richland Creek, to Cope & Fisher, 420 South Franklin St., Decatur, $456,780 base. ($448,780 under alternates accepted.) Award subject to **P.W.A.** approval and outcome of referendum election on $282,000 bond election June 16. Bids May 4. Noted May 28, C. D.

★ **N. Y., Buffalo**—Buffalo Sewer Authority, City Hall, constructing portion of sewer project in Erie Canal, between Charles and Front Sts., to Merritt, Chapman & Scott, 17 Battery Pl., New York, $738,345. **P.W.A.** Bids May 19. Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

Wis., Kaukauna—City, sewage disposal plant, to P. & D. General Contractors, Inc., 607 West Mitchell St., Milwaukee, $122,112•••equipment for sewage disposal plant, Div. A-A, sludge dewatering equipment, to Oliver United Filters, Inc., 221 North La Salle St., Chicago, Ill., $17,531•••Div. A-B, incinerator equipment, to Nichols Eng. & Research Corp., 40 Wall St., New York, $40,970. Grand total $180,613. **P.W.A.** Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

BRIDGES AND GRADE CROSSINGS

PROPOSED WORK

Calif., Auburn—Supervs. Placer Co. rejected bids May 5, constructing 85 ft., steel span bridge over Coon Creek, on steel pile founds., north of Lincoln, and 70 ft. steel span bridge on steel pipe founds. over Dry Creek near Roseville. Will readvertise. Noted May 15, C. D.—Apr. 23, E. N.-R.

Iowa—State Hy. Comn., Ames, soon takes bids constructing one 130x24 ft. continuous I-beam overhead bridge on secondary road at C.G.W.R.R. crossing east of Rowan, Franklin and Wright Counties, incl. 210 cu.yd. Class 1 excav.; one 130x24 ft. continuous I-beam overhead bridge on secondary road south of U. S. Rd. 1, Tippecanoe Twp., Henry Co., 110 cu.yd. Class 1 excav.; one 30 ft. undergrade crossing structure, 1 rein.-con. box culvert, one 40x24 ft. I-beam bridge, 268 cu.yd. Class 1 and 130 cu.yd. Class 2 excav. on secondary road, southwest of Livermore, Humboldt Co. F. R. White, state hy. engr.

Ia., Orchard—Bd. Spervs. Mitchell and Floyd Counties, Charles City, plans constructing new 250 ft. deck plate bridge over Cedar River. $30,000.

Ia., Waterloo—Bd. Supervs. Black Hawk Co. rejected bids May 11, constructing two 34 ft. I-beam bridges. Noted May 5, C. D.

Mass., Medford—Commonwealth of Massachusetts, Metropolitan Dist. Comn., W. E. Whittaker, secy., 20 Somerset St., Boston, making plans structural steel span bridge with rein.-con. abutments over Mystic River. $75,000.

Missouri—State Hy. Comn., Jefferson City, plans constructing three 12 ft. rein.-con. slab span bridge over Batchelor Creek and two 12 ft. rein.-con. slab spans over Bishop Branch on Auxvasse-Shamrock Rd., Callaway Co.; two 15 ft. rein.-con. slab span bridge over Dry Creek, Amoret-Amsterdam Rd.; two 10 ft. rein.-con. slab spans over stream, Adrain-Merwin Rd.; two 10 ft. rein.-con. slab spans over Plum Creek, same road; and two 10 ft. rein.-con slab spans over Nabbos Creek, same road, all foregoing Bates Co.; three 12 ft. rein.-con. slab spans over Claybough Creek, and three 12 ft. rein.-con. slab spans over Palmer Creek, Iron Co.; two 10 ft. rein.-con. slab spans over stream and one 12 ft. rein.-con. slab span over Dry Branch on Horton-Stotesbury Rd., Vernon Co.; two 10 ft. rein.-con. slab spans over Dry Creek; three 30 ft. rein.-con. slab spans over Dry Creek, one 16 ft. rein.-con. bridge over stream, three 10 ft. rein.-con slab spans over stream, one on Anderson-Rocky Comfort Rd., McDonald Co.; two 12 ft. rein.-con. slab span bridge over Riggs Creek and one 10 ft. rein.-con. slab span over stream on McKittrick-Rhineland Rd., Montgomery Co.; two 31 ft. I-beam spans over Boone Creek, Franklin Co.; one 12 ft. rein.-con. bridge over branch Creve Cour Creek, St. Louis Co.; two 10 ft. rein.-con. slab spans over branch of Lake Creek, Route 47-Eastward, Warren Co.; two 30 ft. rein.-con. deck girder spans and 22 ft. roadway over Allen Branch, Potosi West, Washington Co.; three 31 ft. I-beam spans over Blackberry Creek, Route 57-Route SB, Jasper Co. T. H. Cutler, ch. engr.

Neb., North Platte—City election June 30, for bonds for constructing viaduct over Union Pacific R.R. tracks. To exceed $100,000. Former election held illegal owing to irregularities. Noted Apr. 22, C. D.—Apr. 30, E. N.-R.

★ **New York** — Triborough Bridge Authority, 111 8th Ave., New York, plans constructing 4,000 ft. suspension bridge from Ferry Point, Bronx Boro to Whitestone, Queens Boro. $12,000,000.

N. Y., Port Jervis—Erie R.R. Co., R. C. Falconer, ch. engr., Midland Bldg., Cleveland, O., soon takes bids eliminating Pike Street Crossing. $342,700. Will also expend under direct labor with own forces about $105,000 in connection with above elimination and incidental changes and improvements. Noted Jan. 22, 1934, C.D.—Jan. 25, 1934, E.N.-R.

North Carolina—State Hy. and P. Wks. Comn., Raleigh, rejected bids May 7, overhead crossing, Project 4784, in Varina, Wake Co. Will readvertise. W. V. Baise, Raleigh, engr. Noted May 18, C. D.

North Carolina—State Hy. and P. Wks. Comn., Raleigh **(P. means Project)**, making plans overhead crossing over Atlantic Coast Line R.R., U. S. Route 258, north of Tarboro, P. 1240, Edgecombe Co., $21,000; overhead crossings over Norfolk & Southern R.R., near Duncan, P. 250, $12,000; over Atlantic Coast Line R.R. near Spout Springs, P. 251, $11,000, both in Harnett Co.; overhead crossings over Norfolk & Southern R.R., at Corinth, P. 339, Chatham Co., $16,000; over Atlantic Coast Line R.R. south of Red Springs, P. 3933, Robeson Co., $21,000; over Norfolk & Southern R.R. at McCullers, P. 4885, Wake Co., $11,000; underpass on Route 190, south of Marion, Southern & Clinchfield R.R., P. 8542, McDowell Co., $45,000. Total $137,000. W. L. Craven, Raleigh, bridge engr.

Pa., Hollidaysburg—Comrs. Blair Co., J. R. Bassler, co. controller, in charge, making plans 150 ft. clear span girder type bridge on Lakes to Sea Hy. in Schoenberger; 85 ft. clear span, girder type bridge with timber deck and bit. wearing surface, Frankenstown Twp. C. Stout, 408 Mulberry St., engr. Noted Apr. 3, C.D.—Apr. 9, E.N.-R.

Pa., Johnstown—City, City Hall, revising plans temporary bridge across Conemaugh River at Poplar St. to replace span washed out by flood in March. $25,878. W.P.A. project. H. Lee Wilson, City Hall, engr. First plans for project disapproved by W.P.A.

Pa., Scranton—City, W. Schunk, dir. Dpt. P. Wks., plans repairs and alterations to hy. bridges in Linden St. and Spruce St., $50,000. C. F. Schroeder, city engr.

Pa., Williamsport—Comrs. Lycoming Co., Williamsport, M. C. Krause, co. engr., and New York Central R.R., also State Hy. Dpt., Harrisburg, plans relocation of underpass on Route 220, at Larry's Creek crossing of railroad company, incl. relocation of hy. from point at west end of bridge of Larry's Creek, relocation of underpass to make tunnel 70 ft. long, 44 ft. wide with 14 ft. clearance and 5 ft. walk, entire improvement to be 1 mi. 200 ft. long. $168,000.

Texas—State Hy. Comn., H. Hines, chn., Austin, soon takes bids constructing S.A.U. and G. R.R. underpass, approaches and concrete pavement, Hy. 9, WPGH 657-F, San Patricio Co., $110,000; T. and N.O. R.R. underpass, approaches, drainage structures, concrete pavement, on Frio Rd. near Kelly Field, WPGS 857 A and Control 900-1-6 Bexar Co., $137,000. New P.W.A. project.

Texas—State Hy. Comn., H. Hines, chn., Austin, soon takes bids H. and T. C.R.R.,G.C. and S.FeR.R. and M.K. and T.R.R. underpass, or steel, concrete on East Rio Grande Ave., MPGM 847-A, Ft. Worth, Tarrant Co., $150,000; L.A. and T.R.R. overpass, on Hy. 49, WPGH 208, 2¼ mi. west of Hughes Springs, Morris Co., $43,500. New P.W.A. project.

Wash., Seattle—City Lighting Dpt., City Light Bldg., plans steel span replacing wooden trestle carrying Pipe Line 5, across Canyon Creek in Cedar River watershed. $70,000. T. R. Beeman, County-City Bldg., engr.

Wash., Tacoma — Pierce Co., Court House, soon takes bids constructing bridge over Orting. $54,000. F. R. Easterday, Court House, engr.

Que., Joliette — Municipality making plans widening bridge, DesDalles St. $40,000. E. H. Lippe, City Hall, engr.

BIDS ASKED

★ **California**—June 10, by State Hy. Comn., Sacramento, C. H. Purcell, state hy. engr., constructing 6 undergrade crossing structures under tracks of Southern Pacific and Western Pacific Railroads, constructing 1 bridge, and about 2.89 mi. grading, concrete paving and plant-mixed on crusher run base surfacing near Niles, Alameda Co. $700,000.

†*Federal Government*

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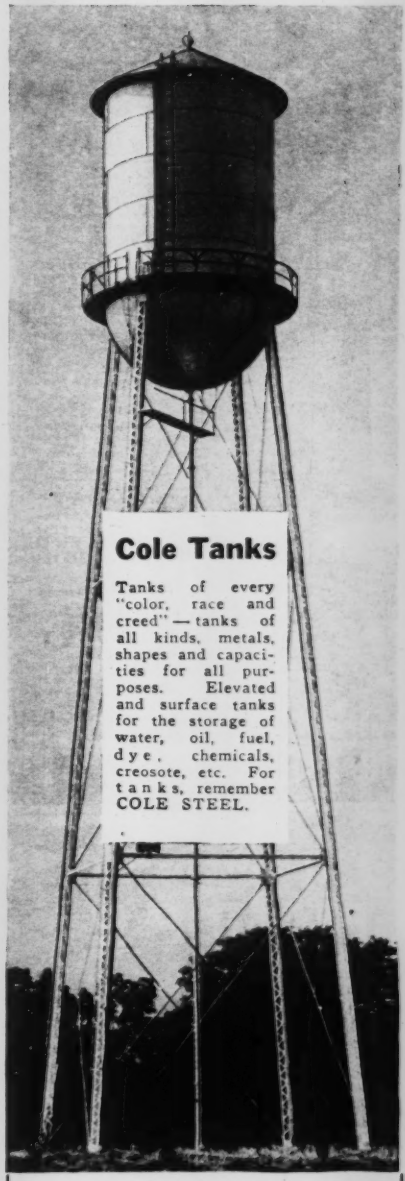

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Bridges, etc. (Continued)

Calif., Oakland—June 9, by Supervs. Alameda Co., constructing Bell Ranch Bridge, steel truss type, over Alameda Creek on Decoto Rd., in Decoto, Washington Twp. $40,000. B. Hamilton, Court House, co. engr.

Ind., Fort Wayne—June 23 (tentative), by State Hy. Comn., Indianapolis, constructing rein.-con. underpass under Pennsylvania and Wabash R.R., at Clinton St., for Bd. P. Wks., City Hall, and State Hy. Comn., Indianapolis. $250,000. M. R. Keefe, state hy. engr.

Ia., Waverly—June 3, by Bremer Co., H. J. Stumme, and. bridges on 2 mi. County Trunk Rd. D, east of County Road H, over Wapsie River, incl. 1 rein.-con. box and 2 rein.-con. pipe culverts, four 32x20 ft. I-beam span bridges, 292x20 ft. continuous I-beam bridge and two 20x20 ft. I-beam bridges. W. S. Chapman, co. engr.

Kansas—See "Streets and Roads."

Ky., Louisville—See "Waterworks."

Louisiana—June 3, by State Hy. Comn., Baton Rouge, overpass and approaches 0.747 mi. Mansfield-Shreveport Hy., Route 1, Project 2502, WPGH 327-A, De Soto Parish; on 0.351 mi. Pearl River-Slidell Hy., Route 2, Project 6112, WPGH 76-E, St. Tammany Parish.

Louisiana and Texas—June 10, by State Hy. Comn., Baton Rouge, La. and at office of G. Gilchrist state hy. engr., Austin, Tex., bridge on 0.356 mi. Leesville, La.-Jasper Tex. Hy., Route 21, Project 968, WPH 333, Vernon Parish La., and Newton Co., Tex.; bridge on 0.266 mi. Starks Intersection Tex. State Route No. 87, Route 7, Read 1909, WPSS 822, Calcasieu Parish, La. and Newton Co., Tex.; bridge Pendleton Ferry Crossing, Project 5253, WPH 862, Texas 21 and Louisiana 6, Routes, Sabine Parish, La., and Sabine Co., Tex.; adv. E. N.-R., May 28.

★ **Md., Baltimore**—City, Municipal Bldg., bids about June 10, bridge over Colgate Creek, $500,000. J. E. Greiner Co., 1201 St. Paul St., engrs. Noted Feb. 13, C. D.—Feb. 21, E. N.-R.

Mass., Springfield—June 2, by City, C. W. Phillips, supt. Street Dpt., Administration Bldg., 52 ft. span rigid steel frame stone trim bridge and underpass, State St., $45,000. H. F. White, 496 Bridge St., Springfield, engr. Noted May 11, C. D.—May 14, E. N.-R.

New York—June 9, by A. W. Brandt, comr. Hys., Albany, constructing 102 ft. timber trestle bridge on Mountain Rd., WPSO 914-B, Allegany Co., $50,745***eliminating 59 ft. girder bridge with two 22 ft. I-beam approaches on Machias-Delevan Rd., Part 1, Cattaraugus Co., $44,994 ***42 ft. I-beam bridge, concrete approaches on Bath Avoca Rd., SH 5204, Steuben Co., $86,902; 19 ft. slab and 45 I-beam bridges, Culvert 26, Freemans Hollow Rd., Bridge 27, Harrisburg-Hollow Rd., 24 ft. rigid frame Bridge 40, Harrisburg Hollow-Cold Spring Rd., and Bridge 107, Cold Spring Rd., and Bridge 109 on Cold Spring Rd., Steuben Co., $62,939; adv. E. N.-R., May 28.

N. Y., Kingston—June 16, at office F. H. Stang, clk. Bd. Supervs. Ulster Co., constructing steel highway bridge with concrete abutments known as Bailey Bridge over East Branch Neversink Creek, in Denning; also for Long Year Bridge over Woodland Creek, in Shandaken.

North Dakota—June 5, by State Hy. Comn., Bismarck, constructing overhead structure and approaches, west of Selz, WPGH 48C, Pierce Co., incl. 53,778 cu.yd. unclassified excav.; 0.151 mi. underpass structure and approaches in West Fargo, 13,651 cu.yd. unclassified excav.; 0.227 mi. State hy. west of West Fargo, WPGS 605, Cass Co., 21,051 cu.yd. unclassified excav.; underpass, approaches, etc., 0.201 mi. State hy. in Dickinson, WPGM 14C, Stark Co. To exceed $72,000. W. J. Flannigan, comr.

North Dakota—See "Streets and Roads."

Ohio—See "Streets and Roads."

Pennsylvania—June 5, at office W. Van Dyke, secy. Hys., Harrisburg, steel plate girder overpass, bituminous on native stone or crushed aggregate surfacing, grading, drainage of railroad bed, etc., 7,322 ft., R-588, Sect. 6, Guilford Twp., Franklin Co., involving 27,062 cu.yd. Class 1 and 2,644 cu.yd. Class 2 excav.

Pennsylvania—See "Streets and Roads."

Wisconsin—June 5, by State Hy. Comn. and County Hy. Committees of Boston, Kenosha, Sauk and Vernon Counties, Madison, constructing Bridge 132, one 31 ft. I-beam concrete, and timber trestle span, Reedsburg-Baraboo Rd., S. T. H. 23 and 33, State Project 1579, Sauk Co.; constructing one structure, three 8 ft. spans, triple box, 17 rein.-con. box culverts, Pewaukee-Watertown Portage Rd., U. S. H. 16, Fed. Aid Project 51, Reop. 425 E Reop., Columbus Co.; new deck for Bridge 20, extension of culverts 853, 855, 856 and 857, Green Bay Rd. South County Line Thiensville Sect., S. T. H. 57, U. S. Wks. Project WPMH 458G, Ozaukee Co.; constructing Bridge 235, one structure, six 23 ft. I-beam concrete and timber span trestle, Fountain City Cream Rd. S. T. H. 88, State Project 5493, Buffalo Co.; Bridge 168, one 228 ft. high truss structure, Wheeler Nort[illegible] Rd. C. T. H.G. U. S. Wks. Project WPSO 66[illegible] Dane Co.; Bridge 219, one structure three [illegible] truss spans, Cameron Ladysmith Rd., [illegible] S. H. 8, Fed. Aid Project 240C, Rusk Co.; Bridge [illegible] one structure two 24 ft. 7 I-beam [illegible] timber trestle span, Bridgeport -Wauzeka Rd. S. T. H. 60, Fed. Aid Project 106, Reop. Crawford Co.

Que., St. Hyacinthe—See "Contracts Awarded."

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CONTRACTS AWARDED

Alabama—State Hy. Dpt., Montgomery, constructing concrete, steel bridge over A. C. L. R.R. on 0.069 mi. WPGM 15B, in Dothan, Houston Co., to W. F. Scott, Thomasville, $43,599. Noted May 14, C. D.—May 21, E. N.-R.

Alabama—State Hy. Comn., c/o G. Scott, pres., Montgomery, concrete, steel overhead crossing 0.067 mi. hy., East Thomas, WPGM 59 C-1, Jefferson Co., to Dunn Constr. Co., Chamber of Commerce Bldg., Birmingham, $53,990. Bids Dec. 4. Noted Nov. 29, C. D. under "Streets and Roads."

†**Arizona and California**—U. S. Reclamation Service, Federal Bldg., Yuma, Ariz., constructing railroad and highway bridge and highway crossing structure, on All American Canal, to D. H. Ryan, 1615 Fern St., San Diego, Calif., $155,447. Bids Apr. 16. Noted Apr. 23, C. D. —Apr. 2 E. N.-R.

California—State Hy. Comn., Sacramento, constructing undergrade crossing under tracks of Southern Pacific Co. and Western Pacific R.R. Co., San Leandro St., Oakland, to Bodenhamer Constr. Co., Box 67, Oakland, $211,065, $372,000 federal funds allotted for same. Bids Apr. 29, awarded May 12. Noted May 4, C. D.

Colorado—State Hy. Dpt., Denver, railroad overpass and bridge with gravel surfaced approaches 0.946 mi. hy. east of Pueblo on State Hy. 16, W.P.M.H. 18, Pueblo Co., to Larson Constr. Co., 1902 Blake St., Denver, $198,419. Bids Apr. 23, Noted Apr. 20, C.D.

Connecticut—State Roads Comn., J. A. Macdonald, state hy. comr., Hartford, twin 60 in. pipe culvert, loose gravel ramp road and rolled bank run graveling 13,800 ft. hy., Painter Ridge River and Squire Rds., Roxbury, to Hy-Way Constr. Co., 73 Steuben St., Bridgeport, $28,970. Bids May 11. Noted May 18, C. D. under "Bridges and Grade Crossings," and May 7, E. N.-R., under "Streets and Roads."

D. C., Wash.—District Comrs., District Bldg., constructing overpass at Michigan Ave., to James Baird, 810 18th St. N.W., $242,171. Noted Apr. 28, C. D.—Apr. 16, E. N.-R.

Indiana—State Hy. Dpt., Indianapolis, constructing 2 bridges in Vigo Co., to F. Lloyd Sullivan, $17,846 est. $18,432***302 ft. bridge in Lake Co., to Ellington-Miller Co., 25 East Jackson Blvd., Chicago, Ill., $168,930 est. $185,022***74 ft. bridge in Clark Co., to Wilmore Paving Co., Middletown, O., $89,598 est. $80,845***33 ft. bridge in LaPorte Co., to Ellington-Miller Co., 25 East Jackson Blvd., Chicago, Ill., $65,382 est. $66,006. Grand total $341,756. Bids Apr. 28. Noted May 4, C. D.—Apr. 23, E. N.-R.

Indiana — State Hy. Comn., Indianapolis, constructing 9 span 428 ft. bridge in Lake Co., to E. T. Strom & Co., 5500 East 8th Ave., Gary, $197,868. Est. $213,329. Bids Feb. 4. Noted Feb. 7, C. D.—Jan. 23, E. N.-R.

Iowa—State Hy. Comn., Ames, 2 rein.-con. pipe and 4 rein.-con. box culverts in Delaware Co., to C. Elliott, Independence, $2,833*** 122x24 ft. continuous I-beam bridge in Fayette Co., to A. Olson Constr. Co., Waterloo, $12,027 ***1 concrete box culvert extension and 1 concrete pipe culvert extension in Lyon Co., to E. M. Duesneber, Inc., Mason City, $2,647 ***312x24 ft. cantilever thru plate girder overhead crossing structure and 1 rein.-con. pipe culvert in Mahaska Co., to O'Rourke Constr. Co., 1118 Mulberry St., Des Moines, $42,349*** 1 corrugated metal pipe culvert extension and 5 rein.-con. pipe and 4 rein.-con box culverts in Polk Co., to J. J. Grose, Prairie City, $2,335 ***120x20 ft. continuous I-beam bridge in Clarke Co., to Duvall & McKinney, Logan, $9,361. Grand total $71,552. Bids May 12. Noted May 18, C. D.—May 7, E. N.-R.

Ia., Allison—See "Materials and Equipment."

Massachusetts—Commonwealth of Massachusetts, Dpt. P. Wks., W. F. Callahan, comr., 100 Nashua St., Boston, grade crossing project W.P.G.H. 280-A, through steel plate girder railroad bridge with bituminous macadam surfacing, Amherst, to C. I. Hosmer, 87 Prospect St., Greenfield, $58,759. Bids May 5, awarded May 14. Noted May 11, C. D.—Apr. 30, E. N.-R.

Massachusetts—Commonwealth of Massachusetts, Dpt. P. Wks., W. F. Callahan, comr., 100 Nashua St., Boston, soil test borings for various proposed hy. and bridge construction at Pembroke, West Bridgewater, Milford, Holliston, Leominster and Fitchburg, to Chas. A. Leary Co., 44 School St., Boston.

Michigan—State Hy. Comn., Roosevelt Hotel, Lansing, constructing grade separation WPGM X6 of 52-9-2C-1 and 52-31C-2, Marquette Co.,

†*Federal Government*

Bridges, etc. (Continued)

to Dutton-Kelly Co., 640 New Center Bldg., Detroit, **$186,265**; grade separation WPGM X1 of 21-6-1C and 21-15C-3, Gladstone, Delta Co., to Gosner & Co., and A. T. Barnes, Gladstone, **$130,443**. Bids Apr. 30. Noted May 7, C. D.

★**Mich., Detroit** — Wayne Co. and State of Michigan, furnishing labor, materials, equipment, constructing grade separation, two 47 ft. 3 in. steel, rein.-con. spans on rein.-con. piers and abutments over Livernois Ave. and Michigan Central R.R., to W. J. Storen Co., 2411 14th St., **$110,053**. Noted Aug. 23, C. D.—Aug. 29, E. N.-R.

Missouri—State Hy. Comn., Jefferson City, three 33 ft. I-beam bridge over Hubble Creek Overflow and five 41 ft. I-beam bridges in Cape Girardeau Co., two 23 ft. and one 39 ft. bridge over Stevenson Bayou and one 49 ft. bridge over Lateral 7, Dist. 29, both Mississippi Co., to Linus Penzel, Jackson***four 21 ft. and one 50 ft. I-beam underpass under C.B. & Quincy R.R., and three 12 ft. rein.-con span bridge over Rush Creek, both Clay Co., to O. W. Knutson, 3520 Main St., Kansas City***bridges over Dry Fork of Meramec River, and over West Fork Meramec River, Dent Co., to Carte Harlin Constr. Co., West Plains***two 50 ft. and three 55 ft. rein.-con. deck girder span bridge over St. Louis & San Francisco R.R., Jasper Co., to Neyer Constr. Co., Billings*** two 6 ft. concrete slab spans over creek, Boone Co., to Vaughn Constr. Co., Kirksville***one 70 ft. deck girder span and one 5 ft. span continuous bridge over Big Blue River and railroad tracks, Jackson Co., to W. A. Ross Constr. Co., 25th and Summit Sts., Kansas City ***285 ft. bridge over Big Blue River, Jackson Co., to List Constr. Co., Railway Exch. Bldg., Kansas City. Bids Apr. 10. Noted Apr. 16, C. D.—Apr. 2, E. N.-R.

★**New York**—Dpt. P. Wks., Albany, constructing bridges in Monroe Co., to Foley Bros., Inc., 135 East 42nd St., New York, **$129,020** est. $168,203***on 0.57 mi. road in Genesee Co., to Bero Eng. & Constr. Corp., 272 Vandervort St., North Tonawanda, **$212,646** est. $261,598***on 0.28 mi. road in Franklin Co., to Belmar Contg. Co., Proctor Bldg., Troy, **$64,666** est. $87,729***on 3.1 mi. road in Rensselaer Co., to Fitzgerald Bros. Constr. Co., Inc., Proctor Bldg., Troy, **$116,342** est. $149,201. Grand total $522,674. Bids May 5. Rejected bids May 5, bridge in Allegany Co. Noted May 7, C. D.—Apr. 30, E. N.-R.

N. Y., East Fishkill—New York, New Haven & Hartford R.R. Co., E. E. Oviatt, ch. engr., New Haven, Conn., constructing grade crossing elimination at Carol and Main Sts., to Lathrop & Shea Co., 178 Goffe St., New Haven, Conn., **$66,978**. Est. $103,840.

N. Y., Syracuse—New York Central R.R. Co., J. W. Pfau, ch. engr., 466 Lexington Ave., New York, altering abutments of grade crossing elimination at Hiawatha St., to Walsh Constr. Co., Herald Bldg. Est. $85,000. Noted May 4, C. D.—May 7 E. N.-R.

North Dakota—State Hy. Comn., Bismarck, constructing rein.-con. pedestrian underpass under Northern Pacific Ry. Co., at Mandan, WPGM 607, Morton Co., to Rue Constr. Co., Bismarck, **$32,910**. Bids Apr. 24. Noted May 1, C.D.—Apr. 9, E.N.-R.

Vermont—State Hy. Dpt., H. E. Sargent, ch. engr., Montpelier. Edwards Bridge, Emery Bridge and Third Bridge, Topsham, to Ryan & Densmore, Claremont, N. H., **$13,882***Burley Bridge, to B. A. Barton Constr. Co., Inc., Main St., Vergennes, **$7,862***Orwell Bridge, Orwell, to E. L. Knight, South Royalton, **$7,467**. Grand total $29,211. Bids Apr. 24, awarded May 12. Rejected bids Apr. 24, bridge, Project WPSO 156-B, Grafton. Noted Apr. 30, C. D.

Que., St. Hyacinthe — Municipality, reconstructing 4 steel spans 1,000 ft. bridge, day labor. $90,000. J. Bouchard, engr., St. Hyacinthe, will purchase all materials.

STREETS AND ROADS

BIDS ASKED

Colorado—June 3, by State Hy. Dpt., Denver, gravel surfacing 4.602 mi. road between Del Norte and South Fork State Hy. 10, Fed. Aid Project 243 F, Rio Grande Co., incl. 93,000 cu.yd. unclassified excav.

Conn., Shelton—See "Contracts Awarded."

Indiana—June 2, by State Hy. Comn., Indianapolis, bituminous coated aggregate surfacing 8.13 mi. road from Culver to Plymouth, S.R. 17, N.R.S. 439, Marshall Co.; 4.047 mi. Greendale to Ohio State line, S.R. 50, Dearborn Co.; grading, rein.-con. paving, grading and bituminous concrete paving or grading and rock asphalt paving 2.733 mi. road from Muncie to southwest, S.R. 67, F.A. 72, Delaware Co.; rein.-con. paving and rock asphalt resurfacing 0.577 mi. road north from Jackson and 5th Sts., Anderson, S.R. 9, WPMH 83 C, Madison Co.; 1.011 mi. 3rd and Liberty Sts., Covington, S.R. 34, Fountain Co.; bituminous retread on stabilized base surfacing 1.087 mi. Taswell east S.R. 64, WPGS 298C, Crawford Co.; 1.136 mi. relocation just west of Salem, S.R. 60, WPGS 622 A, Washington Co. J. D. Adams, chn.

Ia., Spirit Lake—Dickinson Co., C. W. Moeller, aud., rejected bids May 18, graveling 16 mi. local county roads, incl. 48,000 cu.yd. haul and 112,000 cu.yd. cast excav. Will readvertise. R. A. Furman, co. engr.

Kansas—June 6, by State Hy. Comn., at office of County Clerk, Concordia, bituminous mat surfacing, resurfacing, sand gravel or limestone for cover material surfacing, earthwork, culverts, scale house and approaches 97.718 mi. hys. in Clay, Cloud, Dickinson, Jewell, McPherson, Morris and Republic Counties.

Kansas—June 9, by State Hy. Comn., at office of County Clerk, Ottawa, roadside improvement, resurfacing, crushed stone surfacing, keystone for cover material surfacing, chat or limestone for cover material, light type surfacing, scale house and approaches, flint gravel resurfacing, bituminous drag treatment 110.339 mi. hys. in Montgomery, Linn, Labette, Greenwood, Franklin, Elk, Crawford, Coffey, Bourbon, Anderson, Miami and Allen Counties.

Kansas—June 11, by State Hy. Comn., at office of County Clerk, Winfield, earthwork, culverts, concrete paving, bituminous mat surfacing, bridging, roadside improvement, light type surfacing 108.425 mi. hys. in Butler, Cowley, Comanche, Harper, Kiowa, Pawnee, Pratt, Rush, Sedgwick, Barber and Barton Counties.

Minnesota—June 5, by State Hy. Comn., St. Paul, grading 2.3 mi. State Project 152-129-24, F.A.P. 473-E, Clearwater, incl. 144,906 cu.yd. excav. $40,000.

Minn., St. Paul—June 2, by State Hy. Dpt., St. Paul, furnishing and applying 6,000,000 gal. bituminous materials on various trunk highways.

New York—June 9, by A. W. Brandt, comr. Hys., Albany, concrete paving 3.36 mi. Endicott SH 174, Lestershire Rd. SH 125, and Hooper Johnson City Rd. SH 5699-A, Project 401-B, Broome Co., $86,282; 3.58 mi. Falconer-Kennedy Rd. SH 698, and Levant-Poland Center Rd., SH 5053, Chautauqua Co., $90,721; 5.85 mi. Pratt Corners-Sinclairville Rd., DSH 1471, Chautauqua Co., $136,387; 4.8 mi. Angola-Brant Farnham Rd. SH 642, Erie Co., $87,264; 0.22 mi. Yonkers City-Tuckahoe Rd., WPMS 936-A, Westchester Co., $21,749; shale bituminous surfacing 3.76 mi. Cayuga Co., $80,919; adv. E. N.-R., May 28.

N. Y., Ithaca—June 9, by Dpt. Health, State Office Bldg., Albany, constructing roads at Herman M. Biggs Memorial Hospital. $40,840.

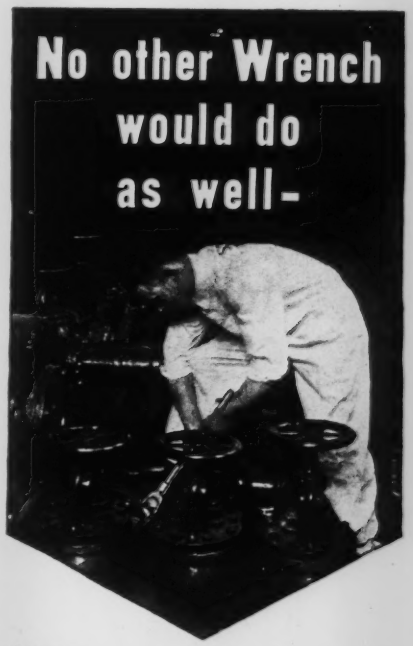
N. Y., Warwick—June 9, by Dpt. Social Welfare, State Office Bldg., Albany, constructing roads and bridge at New York State Training School for Boys. $26,546.

North Dakota—June 5, by State Hy. Comn., Bismarck, grading, constructing overhead 6,754 mi. road west of Churches Ferry, WPGH 27 and WPH 27, Benson Co., incl. 62,768 cu.yd. unclassified excav.; grading and structures 3.703 mi. road in Surry East and West, WPGH 81, Ward Co., 78,614 cu.yd. unclassified excav.; 3.678 mi. road in Hasen South, WPMS 590, WPSO 590, Mercer Co., 72,486 cu.yd. unclassified excav.; 11.289 mi. road southwest of Mott, WPH 427A, Hettinger Co.; 6.298 mi. Inkster east, north and south WPGH 131A, and WPGM 131A, Grand Forks Co., 96,452 cu.yd. unclassified excav.; 4.185 mi. road west of Bowbells, WPSO 457, Burke Co., 38,030 cu.yd. unclassified excav. W. J. Flannigan, state hy. comr.

Ohio—J. J. Jaster, Jr., Hy. Dir., Columbus, received no bids May 5, improving 2.285 mi. part Broadview Heights Sect. and part Brecksville Sect., Twinsburg Elyria Rd., State Hy. 36, State Route 82, Cuyahoga Co., $8,197; 2.18 mi. Sect. E and part Sect. Cheviot Harrison Rd., State Hy. 42, U. S. Route 52, Hamilton Co., $9,665; 4.224 mi. Sect. F, Sect. G, part Findlay Sect., Findlay Kenton Rd., State Hy. 221, State Route 31, Proposal 1, $9,858; 0.051 mi. part Sect. F, same road, State Hy. 221, U. S. Route 68, Proposal 2, $281, both Hancock Co.; 4.384 mi. part Sect. Kent Sect. D, part Ravenna Sect., Kent Ravenna Rd., State Hy. 323, State Route 5, Portage Co., $9,896. Noted May 4, C. D.—May 7, E. N.-R.

★**Ohio**—June 2, by J. J. Jaster, Jr., Hy. Dir., Columbus, bituminous macadam surface treating 1.295 mi. part Sect. A, Ashland Medina Rd., State Hy. 139, U. S. Route 42, Montgomery, Perry and Jackson Twps., Ashland Co., $7,133-$7,491; 1.657 mi. part Sect. E, Logan Athens Rd., State Hy. 155, State Route 31, Athens Co., $7,253-$7,301; 11.91 mi. Sects. P and Q and Fayetteville Sect., Milford Hillsboro Rd., State Hy. 9, U. S. Route 50, Brown Co., $54,109; 7.639 mi. Sects E, F and G, part Sect. D, Celina Greenville Rd., State Hy. 221, U. S. Route 127, Wabash, York and Richland Twps., Darke Co., $49,371; 15.042 mi. Sects. F-1, F-2, G, H-1 and H-2, part Sect. E, Jackson Gallipolis Rd., State Hy. 399, State Route 11, U. S. Route 35, Green, Springfield and Raccoon Twps., Gallia Co., $74,847-$76,017; 6.301 mi. Sects. M and R, part Sect. P, part Sect. N, part Lodi Sect., part Sect. S-1, Ashland Medina Rd., State Hy. 139, U. S. Route 42, Lodi and Harrisville Villages, Westfield and Lafayette Twps., Medina Co., $24,651-$24,743; 1.764 mi. part Sect. I and H, Pomeroy Jackson Rd., State Hy. 395, State Route 124, Salisbury and Rutland Twps., Meigs Co., $8,645-

†Federal Government Constr. News page 375



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Streets and Roads (Continued)

$8,731; 10.115 mi. Sects. B-1, 2 and C, part Sect. A, Tiffin Fostoria Rd., State Hy. 270, State Route 18, Louden and Hopewell Twps., Seneca Co., $33,524-$40,990; 5.037 mi. part Sect. B, Canton Navarre Rd., State Hy. 511, U. S. Route 62, Perry Twp., Stark Co., $19,146-$19,475; 6.639 mi. Sects. D and H, part Sect. I and part Newton Falls Sect., Ravenna Warren Rd., State Hy. 322, State Routes 5 and 82, Newton, Braceville and Warren Twps., Trumbull Co., $25,449-$30,799; 3.597 mi. part Sect. J and part Sect. K, West Lafayette New Philadelphia Rd., State Hy. 408, State Route 28, York Twp., Tuscarawas Co., $14,467-$15,377; 9.74 mi. Sects. B, D and C, part Sect. E, Upper Sandusky Tiffin Rd., State Hy. 266, State Route 53, Crane and Tymochtee Twps., Wyandotte Co., $36,297; bituminous coated aggregate resurfacing 5.18 mi. Sect. L-1, L-2, L-3, Lima Sandusky Rd., State Hy. 22, U. S. Route 25, Richland Twp., Allen Co., $25,010; bituminous macadam resurfacing 7.639 mi. Sects. I, J and K, Springfield Washington Court House Rd., State Hy. 197, State Route 70, Jefferson and Union Twps., Fayette Co., $42,764; 11.425 mi. Sects. B, C and D, Cleveland Burton Rd., State Hy. 33, State Route 87, Russell, Newbury and Burton Twps., Geauga Co., $50,891; 6.691 mi. Sect. G, part Sect. F, Wickliffe Madison Eastern Rd., State Hy. 563, State Route 84, Perry and Madison Twps., Lake Co., $25,406-$26,013; 6.519 mi. Sects. A-1 and A-2, B, Huntsville Sect., part Sect. C, Lima Bellefontaine Rd., State Hy. 130, State Route 32, Harrison and McArthur Twps., Logan Co., $33,764; 6.417 mi. Sect. B and part Sect. A, Celina Van Wert Rd., State Hy. 262, U. S. Route 127, Jefferson, Hopewell, Center, Dublin and Franklin Twps., Mercer Co., $32,471; roadside improvement 1.33 mi. part Sect. K, Cleveland Buffalo Rd., State Hy. 2, U. S. Route 20, WPH 666 F, Saybrook Twp., Ashtabula Co., $3,291; 0.453 mi. part Sect. O, Dublin Bridge Section, Columbus Marysville Rd., State Hy. 48, State Routes 31 and 161, NRM 517-D, Washington and Perry Twps., Proposal 1, $6,066; 0.439 mi. same road, Proposal 2, $4,224, both in Franklin Co.; 1.96 mi. part Sect. A, Akron Cleveland Rd., State Hy. 16, State Route 8, WPMH 19, Northampton Twp., Summit Co., $7,408; constructing grade crossing elimination Baltimore and Ohio R.R. incl. grading, drainage structures, roadside improvement, temporary railroad run-around, permanent double track railroad structure, 0.298 mi. part Sect. D, part Sect. Brady Lake of Kent Ravenna Rd., State Hy. 323, State Route 5, WPGH 87-D, Portage Co., $193,277. Total $1,065,639.

Pennsylvania—June 5, at office W. Van Dyke, secy. Hys., Harrisburg, rein.-con. paving, 6 rein.-con. structures, bituminous on crushed aggregate surfacing, drainage 25.955 ft. R-18, Sect. I, Fairfield and Muncy Twps., Montoursville Borough, Lycoming Co., incl. 87,946 cu. yd. Class 1, 2,418 cu.yd. Class 2 and 680 cu.yd. borrow excav.; bituminous on native stone or modified crushed aggregate surfacing, incl. timber deck I-beam bridge, 3,167 ft. C.A. Appl. 9976, Otto Twp., McKean Co., 3,719 cu.yd. Class 1, 241 cu.yd. Class 2 and 1,358 cu.yd. borrow excav.

Pennsylvania—See "Bridges and Grade Crossings."

Pa., Johnstown—See "Contracts Awarded."

Wash., Seattle—June 8, by King Co. Comn., grading, graveling, drainage, crib wall, concrete paving 0.5 mi. Puget Sound Marine View Dr., incl. 20,931 cu.yd. unclassified excav. $28,000. Bids Mar. 9, rejected. J. P. Dodd, City-County Bldg., engr. Noted Feb. 20, C. D.—Feb. 27, E. N.-R.

West Virginia—June 2, by State Rd. Comn., Charleston, asphaltic concrete and relaid vitr. brick paving 2.022 mi. Grafton streets, U. S. Wks. Project WPMS 248-A, Taylor Co.; grading, draining, stone base, road mix surfacing 2.563 mi. Grassy Branch to Cumberland Turnpike Rd., U. S. Wks. Project WPSO 269, Mercer Co.; surface treated stone base 0.301 mi. Largent Bridge and approaches, U. S. Wks. Project P.W.S. 2197, 843-C, Morgan Co., 4.747 mi. Fisher Bridge Largent Rd., U. S. Wks. Project PWS 2197, 843-D, Morgan Co.; grading, draining, stone base, asphaltic concrete surfacing 0.169 mi. Cherry Run Bridge and approaches, U. S. Wks. Project, P.W.S. 2197, 843-B, Berkeley and Morgan Counties; grading, draining, shale surfacing 0.631 mi. Romney Bridge approaches, Fed. Aid Project 202-D, Hampshire Co.; constructing one 180 ft. steel through truss, five 100 ft. steel pony truss and two 50 ft. steel I-beam span bridge on concrete substructure, Romney Bridge 1415, U. S. Pub. Wks. NRH 202-C, Hampshire Co.; constructing Bristol Overhead 1417, bridge and approaches, U. S. Wks. Project WPGH 185-D, Harrison Co.

Wisconsin—June 5, by State Hy. Comn. and County Hy. Committees of Boston, Kenosha, Sauk and Vernon Counties, Madison, concrete surfacing 4.353 mi. Milwauke-Chicago Rd. Kilbourn Relocation Sect, U. S. Hy. 41, Fed. Aid Project 378 F, Sect. 2, Kenosha Co., incl. $10,417 cu.yd. common excav.; 4.183 mi. same road, Sect. 1, Contr. 1, 1.105 cu.yd. common and borrow excav.; 1.795 mi. Milwaukee-Green Bay Rd. C. T. H. Q., S. T. H. 60, Sect. U. S. Hy. 141, Fed. Aid Project 479 D, Ozaukee Co., 7,237 cu.yd. common excav.; 0.522 mi. Manitowoc-Two Rivers Rd., Eighth St., city of Manitowoc, U. S. H. 10 and 141, S. T. H. 42, U. S. Wks. Project WPMH 367 F, Manitowoc Co.; draining, concrete surfacing 0.627 mi. River Falls Rd. S. T. H. 35, Fed. Aid 399, Contr. 1, St. Croix Co., 25,971 cu. yds. classified excav.; bituminous surface course gravel shoulder surfacing 7.325 mi. Burlington Rd., U. S. H. 45, West County Sect. S. T. H. 43, State Project 2153, Kenosha Co.; graveling 4.887 mi. Merrill Dudley Merrill County Trunk C, S. T. H. 17, U. S. Wks. Project WPSS 618, Lincoln Co., 5.2 mi. Turtle Lake-Spooner Rd., Turtle-Cumberland, U. S. H. 63, U. S. Wks. Project WPH 385 A, Reop. and Ext., Barron Co., crushed stone surfacing 2.28 mi. road mixed non.; 6.173 mi. Elroy-New Lisbon Rd., S. T. H. 80, State Project 4696, Juneau Co.; 9.8 mi. Pewaukee-Watertown Portage Rd. Rio Colby, U. S. H. 16, Fed. Aid Project 51 Reop. and Ext. E. 425 A, Columbia Co.; 8.903 mi. Laona-Pigan State Line Rd., U. S. H. 8, Fed. Aid Project 462 E, Marinette Co., 445,290 cu.yd. common borrow and marsh excav.; grading, draining 0.615 mi. Fond du Lac-Oshkosh-Appleton Rd., Belt Line Overhead approaches, Town Rd. U. S. H. 41, U. S. Wks. Project WPGH 5-E, Winnebago Co., 273,280 cu.yd. common and borrow excav.; 1.522 mi. Wisconsin Dells-Oxford Rd., Town Rd., U. S. Wks. Project WPSO 2[illegible] Adams Co., 15,780 cu.yd. common excav.; 2.28 mi. Viroqua-Viola Rd. S. T. H. 56, State Project 5526, Vernon Co., 71,305 cu.yd. common excav.; 2.647 mi. Hudson-Menomonie Rd., C. T. H. N, U. S. Wks. Project WPSO 624, St. Croix Co., 98,155 cu.yd. common and borrow excav.; 2.077 mi. Prentice-Ashland Rd., S. T. H. 13, Ashland Co. line Rd., S. T. H. 13, U. S. Wks. Project WPH 405 C, Price Co., 105,410 cu.yd. common, borrow and marsh excav.; 5.152 mi. Merrill-Dudley Road 9, Merrill C. T. H. C, S. T. H. 17, U. S. Wks. Project WPSS [illegible] Lincoln Co., 71,612 cu.yd. common excav.; 6.051 mi. Turtle Lake-Spooner Rd., U. S. H. 63, U. S. Wks. Project WPH 385A, WPMH 385-F, Reop. and Ext., Barron Co., 153,844 cu.yd. common, borrow and marsh excav.; 5.129 mi. Spooner-Superior Rd., U. S. H. 53 and 63, Fed. Aid Project 377A, Washburn Co., 3,675 cu.yd. borrow and 75,722 cu.yd. unclassified excav.; 7.536 mi. Spooner-Superior Rd., U. S. H. 53, Fed. Aid Project 377 E, Reop. and Ext., Douglas Co., 38,209 cu.yd. borrow and marsh excav.; 6.59 mi. Bridgeport-Wauzeka Rd., S. T. H. 60, Fed Aid Project 106 Reop. and Ext., Crawford Co., 197,177 cu.yd. common and borrow excav.; grading, draining, gravel surfacing 1.975 mi., S. T. H. 27, Exeland-Lemington Rd. C. T. H. D., U. S. Wks. Project WPSO 679 A, Sect. 2, WPMS 679 B, Sawyer Co.; grading, drainage structures, graveling, constructing three 33 ft. I-beam and timber span bridge, Sawyer Co., 26,300 cu.yd. common borrow excav.; grading, top soil surfacing 1.8 mi. Janesville-Elkhorn-Racine Rd. 9, Burlington-Kansasville Sect., S. T. H. 11, U. S. Wks. Project WPH 439C, Racine Co., 8,244 cu.yd. common and borrow excav.; furnishing placing roadside treatment materials 1.8 mi. same road.

Que., Quebec City—See "Contracts Awarded."

CONTRACTS AWARDED

Alabama—State Hy. Comn., c/o G. Scott, pres., Montgomery, concrete paving, 2 concrete and steel underpasses 0.63 mi. East Thomas-WPGM 59 C-2, Jefferson Co., to MacDougall Constr. Co., Hemphill Ave. N.W., Atlanta, Ga., **$204,193.** Bids Dec. 4. Noted Nov. 29, C. D.

Alabama—State Hy. Comn., Montgomery, bituminous surface treatment 0.694 mi. of 2nd Ave., WPH 16 and WPMH 16D, Lee Co., and 0.869 mi. Dothan Headland Rd. N.R.M. H150, Houston Co., to Couch Constr. Co., Dothan, **$37,581** and **$49,951** respectively. Noted Feb. 10, C. D.

California—State Hy. Comn., State Bldg., Los Angeles, C. H. Purcell, P. Wks. Bldg., Sacramento, state hy. engr., applying road mix surface treatment 76.5 mi. hy. between Vidal and Route 58, between Doble and point 20 mi. north and between Route 26 and point 11.5 mi. northerly, San Bernardino and Riverside Counties, to R. E. Hazard & Sons, P. O. Box 1438, San Diego, **$88,084.** Bids May 7. Noted May 11, C. D.

California — State Hy. Comn., Sacramento, grading, plant-mixed on crusher run surfacing 3.2 mi. hy. between Broadway Tunnel and point 2 mi. west of Lafayette, Contra Costa, to Granfield-Farrar & Carlin, 67 Hoff Ave., San Francisco, **$306,237.** Bids May 6. Noted May 11, C.D.

†**California**—Pub. Rds., 461 Market St., San Francisco, grading 4.267 mi. road in Sierra and Nevada Counties, to J. R. Reeves, R.D. 3, Box 100, Sacramento, **$92,265.** Est. $93,691. Bids May 7. Noted May 18, C. D.

Calif., Hanford—Supervs. Kings Co., 21,120 lin.ft. grading for shoulder work in headerboards, 3,016 tons asphaltic concrete base material in shoulders and leveling course, 4,984 tons asphaltic concrete top, 11th Ave. and Hanford-Armona Ave., to Union Paving Co., Call Bldg., San Francisco, **$38,005.** Noted May 18, C. D.—May 14, E. N.-R.

Conn., Shelton — State, State Tuberculosis Comn., Hartford, grading, improving sanatorium grounds at Laurel Heights Sanatorium, Owner builds, W.P.A. labor. $29,274. M. A. Daly, New Haven, state administrator.

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†*Federal Government*

Streets and Roads (Continued)

Indiana—State Hy. Comn., Indianapolis, reinforced paving roads. Contrs. 1360 and 1359, to Botranger Constr. Co., 618 West Indiana Ave., Elkhart, **$49,437** and **$170,004** respectively, est. $52,837 and $174,741 respectively***2.254 mi. road in Allen Co., to McAfee & Smith, Bluffton, **$134,430** est. $139,531. Grand total $353,871. Bids Apr. 7. Noted Apr. 13. C. D.—Mar. 19 and 26. E. N.-R.

Indiana — State Hy. Comn., Indianapolis, crushed stone surfacing road. Contr. 1292, to R. Rogers & Co., South High St., Bloomington, $57,178 est. $73,385***rock asphalt paving and resurfacing 1.188 mi. road in Allen Co., to Brooks Constr. Co., 1123 Barthold St., Fort Wayne, **$70,737** est. $78,064. Bids Dec. 17. Noted Dec. 19, C. D.—Dec. 5, E. N.-R.

Indiana — State Hy. Comn., Indianapolis, grading, structures 9.815 mi. road in Madison and Delaware Counties, to Gast Constr. Co., Warsaw, **$93,498** est. $107,117***1.654 mi. Delaware Co., to McCoun Constr. Co., Noblesville, **$118,571** est. $167,719. Bids Apr. 21. Noted Apr. 27, C. D.—Apr. 16, E. N.-R.

Iowa—State Hy. Comn., Ames, paving 0.511 mi. Mahaska Co., and 0.175 mi. Polk Co., to O'Rourke Constr. Co., 1118 Mulberry St., Des Moines, **$21,818** and **$35,081** respectively*** 1.868 mi. Polk Co., to G. G. Herrick, 701 Coring Ave., Des Moines, **$59,463***0.54 mi. Webster Co., to Wright Constr. Co., 102 Forest Ave., Des Moines, **$38,113***grading 1.44 mi. road and graveling 1.44 mi. in Delaware Co., to E. N. Barker, Manchester, **$4,678** and **$2,016** respectively***0.331 mi. Lucas Co., to V. L. Lundeen, Montezuma, **$12,526***0.378 mi. Lyon Co., to Green Constr. Co., 605 Crocker Bldg., Des Moines, **$13,020***graveling 6.954 mi. Page Co., to Southwestern Constr. Co., Red Oak, **$9,401.** Grand total $196,116. Bids May 12, awarded May 12. Noted May 18, C. D.—May 7, E. N.-R.

Ia., Nevada—Story Co., graveling 61.5 mi. road, to R. Cook, Nevada. **$54,535.** Bids May 15. Noted May 4, C. D.—May 7, E. N.-R.

Kansas—State Roads Comn., Oakley, to Yant Constr. Co., 115 Omaha Natl. Bank Bldg., Omaha, Neb., bituminous mat surfacing 18.196 mi. P. 408-4-FA 375J, Logan Co., **$58,974;** 5.004 mi. P. 408-2-FA 375H, Wallace Co., **$18,050;** 16.287 mi. P. 408-R-FA 375I, Logan Co., **$46,082;** 2.439 mi. P. 408-3-FA 375D, Logan Co., **$7,014***to Ira Rogers, Norton, earthwork and culverts, 0.535 mi. P. 38-9A-FA 344F, Norton Co., **$13,530.** Grand total $144,550. Bids May 5. Noted Apr. 22, C. D.—Apr. 30, E. N.-R.

Ky., Louisville—City, constructing Brownsboro Rd. from State St. to Crescent Ave., to George M. Eady Co., 340 Byrne St., **$123,000.**

Mississippi—E. D. Kenna, dir. State Hy. Comn., Jackson, grading, drainage structures, paving, bridging 0.32 mi. Batesville Sardis Hy., Panola Co., to Pigford Bros., Meridian, **$80,111** est. $87,000***grading, drainage structures, gravel surfacing 3.276 mi. Roxie Meadville Hy., Franklin Co., and 4.809 mi. Bassfield Prentiss Hy., Jefferson Davis Co., to Gerald Smith, Memphis, Tenn., **$38,235** and **$60,645** respectively, est. $41,000 and $8,000 respectively***grading, drainage structures, bituminous surfacing 0.566 mi. and bridge underpass, Meridian Jackson Hy., Rankin Co., to Cobb Bros., and W. L. Bounds, Meridian, **$47,529** est. $52,000***grading, drainage structures 4.862 mi. Franklin Lexington Hy., Holmes Co., and grading, drainage structures, gravel surfacing, bridging 9.005 mi. Sandy Hook Foxworth Hy., Marion Co., to B. E. Harris, Dundee, **$54,954** and **$104,999** respectively, est. $60,000 and $99,000 respectively***grading, drainage structures, paving 0.381 mi. Natchez Washington Hy., Adams Co., to Clarke Bros., Jackson, $13,247 est. $12,000. Grand total $399,720. **P.W.A.** Bids Apr. 28. Noted May 6, C. D.—May 14, E. N.-R.

★ **Missouri**—State Hy. Dpt., Jefferson City, to L. Penzel, Jackson, grading, graveling or crushed stone surfacing 1.975 mi. road in Cape Girardeau Co., **$36,417;** grading 0.089 mi. Route 55-Dornena Rd., **$3,607;** 0.113 mi. Route J to Birds Mill Rd., **$3,374,** both Mississippi Co.*** to List Constr. Co., Railway Exch. Bldg., St. Louis, grading, concrete paving 0.162 mi. 51st St., Kansas City, WPGM 373A, **$28,505;** 0.3 mi. same road, Sect. WPGM 373F, **$249,909,** both Jackson Co.***to Vaughn Constr. Co., Kirksville, 4.345 mi. Boone Co., **$15,499***** to Carte Harlin Constr. Co., West Plains, 2.825 mi. Dent Co., **$34,149***to Neyer Constr. Co., Billings, 0.289 mi. Jasper Co., **$71,419***to O. W. Knutson, 3520 Main St., Kansas City, 0.527 mi. Clay Co., **$83,529.** Grand total $526,408. Bids Apr. 10. Noted Apr. 16, C. D. —Apr. 2, E. N.-R.

Nevada—State Hy. Comn., Carson City, constructing 9.82 mi. Route 47, Sect. A from Blair Junction to point 10 mi. south, Esmeralda Co., to Isabel Constr. Co., 1300 East 4th St., Reno, **$54,795***8.16 mi. road in Elko Co., to G. French, Jr., P. O. Box 107, Stockton, **$68,945.** Bids May 15. Rejected bids May 15, improving 1.56 mi. road in Clark Co. Noted Apr. 24, C. D.

New York—Dpt. P. Wks., Albany, improving 3.28 mi. road in Nassau Co., to Tuckahoe Constr. Co., Inc., 116 Columbus Ave., Tuckahoe, **$229,727** est. $245,783***4.24 mi. Allegany Co., to Lee Constr. Co.; Oaks Corners, **$58,749*****4.99 mi. Fulton Co., to Green Island Constr. Co., Inc., 100 Bleecker St., Green Island, **$51,422.** Grand total $339,898. Bids May 5. Noted May 7, C. D.—Apr. 30, E. N.-R.

N. Y., Farmsville—Pennsylvania R.R. Co., W. D. Wiggin, act. ch. engr., Broad St. Station, Phila., Pa., constructing approaches for elimination of Napier Crossing on Franklinville-Machias State Hy., Cattaraugus Co., to A. K. Van Ingren, Hamburg, **$28,165.**

Ohio—J. J. Jaster, Jr., Hy. Dir., Columbus, adjusting drainage structures, brick paving 3.384 mi. Stark Co., to H. H. Wise, 1126 11th St. N.W., Canton, **$30,349*****drainage structures, traffic bound paving Tuscarawas Co., to Shirley Constr. Co., Beach City, **$12,928*****widening Bridge FA-204-16, concrete beam, with concrete beam construction over Ohio Canal, Fairfield Co., to J. R. Board, 175 East Granville St., Alexandria, **$6,139.** Grand total $49,416. Bids May 15. Noted May 4, C. D.—May 7, E. N.-R.

★ **Pa., Johnstown**—City, repairs and improvements to streets and sidewalks throughout city, cement, concrete and bituminous materials, day labor under supervision of H. Lee Wilson, city engr. Est. $597,681.

Texas—G. Gilchrist, state hy. engr., **Austin,** grading, drainage structures, crusher run rock base surfacing 4.879 mi. State Hy. "F," W.P.S.O. 919-A, Kaufman Co., to Capital Constr. Co., Austin, **$55,627.** Est. $60,000. New **P.W.A.** Bids Mar. 17. Noted Mar. 25, C. D.

Texas—G. Gilchrist, state hy. engr., Austin, grading, drainage structures 5.961 mi. State Hy. "F," WPSO 878-A, Dawson Co., to G. E. Huddleston, Crosbyton, **$23,421.** Est. $40,000. New **P.W.A.** Noted Apr. 13, C. D.

Vermont—State Hy. Dpt., H. E. Sargent, ch. engr., Montpelier, gravel surface course paving 0.5 mi. Route 3, WPSO 211-A, Ira, to O. A. Priest, Belmont, **$11,915***gravel mixed in place with refined tar surfacing 0.7 mi. Route 3, Project WPSO 215-A, Rutland, to Earle & Merry, 42 Burnham Ave., Rutland, **$21,284.** Bids Apr. 24, awarded May 12. Noted Apr. 30, C. D.

Washington — L. V. Murrow, dir. Hys., Olympia, bituminous treatment surfacing 2.62 mi. State Rd. 8, Lyle to Maryhill Junction, Klickitat Co., to Diesel Oil Sales Co., 2155 Northlake St., Seattle, **$18,480*****bituminous surfacing 98.7 mi. State Roads 3, 6 and 11, Whitman, Garfield, Adams and Pend Oreille Counties, to Morris Bros., Burlington, **$83,184*****31 mi. State Rd. 12, Sect. 1, South Bend to Palix River, Sect. 2, Greenhead Slough to Bear River, Pacific and Wahiakum Counties, to J. F. Forbes, Olympia, **$44,691***grading, draining 3.38 mi. State Rd. 3, Colfax South, Fed. Aid Project 35-B, Whitman Co., to Brentsturgill Co., Inc., Morsing, Idaho, **$52,499***grading, draining, concrete surfacing 0.742 mi. State Rd. 2, West Sunnyslope, Wilkinson Corner, Monitor Hill, Revisions, Chelan Co., to J. Coyle, 901 Westlake North St., Seattle, **$68,149***stockpiling bituminous macadam material surfacing 60.1 mi. State Rd. 10, Brewster to B. C. Line, Okanogan Co., to Joslin & McAllister, 3008 East Trent Ave., Spokane, **$12,433***grading, crushed stone surfacing 3.808 mi. State Rd. 9, Lake Sutherland to Elwha River, Clallam Co., to Allen & Govan, Inc., Box 105, Olympia, **$29,976.** Grand total $309,412. Bids May 5. Noted Apr. 23, C. D.

N. S., Halifax — A. S. MacMillan, minister Hys., grading, base course, underdrainage and bituminous surface course paving 24.8 mi. Middleton West Town Line to Annapolis East Town Line (excluding town of Bridgetown), 14.5 mi. Stewiacke East Town Line to East End Old Brookfield Diversion and East Mountain Rd. towards New Glasgow and 6.9 mi. from West Arm Bridge to Robinson Diversion, to Municipal Spraying & Contg. Ltd., 1350 Barrington St.***paving 35.65 mi. from Digby Corner to Saulnierville Church and 25.9 mi. from Freshwater Brook to Pubnico Head, to Acadia Constr. Co. Ltd., 101 Upper Water St.***21.6 mi. from Pubnico Head to Arcadia Corner, to Standard Paving Maritime Ltd., Capitol Bldg.***paving 32.2 mi. from end of 1935 grading at Broadway to Heatherton Church (excluding town of Antogonish) to Dufferin Paving Constr. (Maritime) Ltd., St. John, N. B.***paving 17.2 mi. from Ardoise School to St. Croix Bridge Three-Mile Plains Sect. to end of paving Hantsport Diversion to Wolfville East Town Line including town of Hantsport, to Warren Bituminous Paving Co., Ltd., Halifax***paving 8.1 mi. from end of 1935 paving at Lantz to Shubenacadie Bridge, to St. George Constr. Co., Shubenacadia. Bids Apr. 13, awarded May 2. Noted Apr. 10, C. D.

Ont., Toronto—H. C. Rose, engr., c/o Toronto & York Rds. Comn., 57 Adelaide St., mixed macadam paving 1.75 mi. Bathurst St., to Kilmer Gibson & Van Nostrand Ltd., 375 Fleet St. W. ***surface treatment 50 mi. county roads, to Storens Contg. Co. Ltd., 49 Gwens St., for York Co. Est. $23,000. Noted Apr. 28, C. D.

Que., Quebec City—City Council, constructing permanent sidewalks, day labor. $30,000 voted. City Engineer will purchase material.

†*Federal Government*

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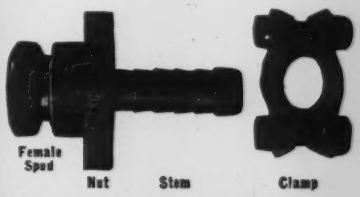

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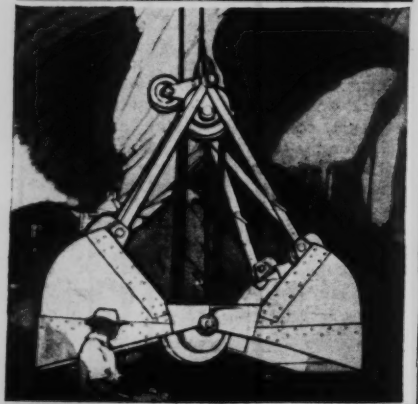

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PROPOSED WORK

★ **California**—Water District formed at election May 5, embracing cities of Martinez, Pittsburg, Antioch and Concord. District will negotiate with Federal Government for construction of $2,500,000 canal between Knightsen and Port Chicago. An election will be called shortly to name 5 directors for district.

Calif., San Jose—Santa Clara Valley Water Conservation Dist. voted $400,000 bonds May 12, to finance completion of several dams in district. F. H. Tibbetts, Alaska Com. Bldg., San Francisco, engr. Noted Apr. 8, C. D.—Apr. 16, E. N.-R.

†**Conn., Norwalk** — U. S. Eng. preliminary survey dredging in Norwalk harbor to make navigable to Wall Street Bridge. $65,000.

N. Y., Binghamton—City, C. A. Harrel, mgr., plans flood control program, 1st section to be repairing wall along bank of Chenango River from Court to Ferry Sts. $200,000 bonds voted. J. A. Giles, city engr.

Okla., Oklahoma City — City, rejected bids May 12, dredging 450,000 yd. in North Canadian River from Walker to Western Sts. $100,000. T. G. Bank, city engr. Noted May 8, C. D.

★ **Pa., Johnstown**—City, D. Shields, mayor, revised plans by H. Lee Wilson, city engr., City Hall, being completed for dredging Conemaugh River through city, $896,814; cleaning Sam's Run, $34,208; dredging and cleaning Cheney's Run, $12,301. Total $943,333. Federal Aid Project. City will submit revised plans either to P.W.A. or W.P.A.

Que., Joliette—Municipality making plans rein.-con. protection wall along L'Anomytion River, $150,000; park improvements, $75,000. E. H. Lippe, town engr.

BIDS ASKED

†**Florida**—June 15, by U. E. Eng., Court House and Post Office Bldg., Jacksonville, dredging 4,000,000 cu.yd. incl. 553,000 cu.yd. rock for widening Drummond Creek Cut, Trout Creek Cut and Six Mile Creek Cut on east sides, and dredging Terminal Channel on east bank of river between Commodore Point and deep water above Six Mile Creek.

†**Maryland**—June 6, by U. S. Eng., 322 Post Office Bldg., Baltimore, dredging 115,000 cu.yd. material for a channel 15 ft. deep, 200 ft. wide in Susquehanna River, below Harve de Grace; adv. E. N.-R., May 28.

†**Massachusetts**—June 2, by U. S. Eng., 13th Fl., Custom House, Boston, Mass., dredging and removing bridge piers in Cape Cod Canal and dredging channel to Onset Bay; adv. E. N.-R., May 28.

†**Mass., Gloucester** — U. S. Eng., Custom House, Boston, Mass., taking bids dredging 81,000 cu.yd. in Annisquam River from Gloucester Harbor to Ipswich Bay and rock removal in Gloucester Harbor, Spec. 175-36-77. To exceed $30,000. (Date not set).

Mass., Hull—June 2, by Commonwealth of Massachusetts, Dpt. P. Wks., W. F. Callahan, comr., 100 Nashua St., Boston, constructing anchorage basin, roadway and park at Harbor of Refuge in Hull. P.W.A. project.

†**Mass., Sandwich**—June 5, by U. S. Eng., Custom House, Boston, constructing steel sheet pile bulkhead on south side Cape Cod Canal, here; adv. E. N.-R., May 28.

†**Michigan**—U. S. Eng., Detroit, taking bids grading 51,389 sq.yd. at Poe Reef Shoal, South Channel, Straits of Mackinac, Lake Huron; adv. E. N.-R., May 28.

†**Minn., Red Wing**—June 9, by U. S. Eng., 615 Commerce Bldg., St. Paul, approach dredging Lock and Dam 3, Mississippi River 6 mi. above here; adv. E. N.-R., May 28.

†**Mont., Fort Peck**—June 2 (extended date), by U. S. Eng., Postal Telegraph Bldg., Kansas City, Mo., emergency gate shafts for Fort Peck Tunnel. Noted Apr. 21, C. D.—Apr. 23, E. N.-R.

★ **Neb., Genoa**—June 4, by Loup River Public Power Dist., completing headworks for district, incl. structural excav. and backfilling constructing river weir, intake Schedule 1; settling basin embankment to provide pilot channels Schedule 2; skimming weir and canal transition, Schedule 3; 1¼ mi. inlet canal, incl. 360,000 cu.yd. excav., Schedule 4; dikes and excavation of new channel for Loup River and diversion of river through that channel, incl. 115,000 cu.yd. dike and 135,000 cu.yd. channel excav., Schedule 5; constructing dikes, 100,000 cu.yd., construction, Schedule 6, $1,000,000. Harza Eng. Co., 205 West Wacker Dr., engrs.

†**North Carolina**—June 18, by U. S. Eng., Wilmington, dredging 75,000 cu.yd. material from Smiths Creek, Pamlico Co.; adv. E. N.-R., May 28.

†**O., Lorain**—U. S. Eng., Buffalo, N. Y., taking bids dredging 127,000 cu.yd. other than ledge rock in Lorain Harbor. (Date not set.)

†**Oregon-Idaho**—June 8 by Bureau Reclamation, Ontario, Ore., earthwork and structure on Sage Creek Main Drain, Succor Creek [illegible] Owyhee Project, incl. 534,000 cu.yd. excav. [illegible] drains, 2,500 cu.yd. excav. for structures, [illegible] Homedale, Idaho.

†**South Carolina**—June 9, by U. S. [illegible] Custom House, dredging 10,239,000 cu.yd. [illegible] Winyah Bay to increase bottom width of [illegible] nel to 800 ft.

†**Washington**—June 11, by U. S. Eng., [illegible] eral Bldg., Seattle, dredging 2,235,000 [illegible] from Swinomish Slough from Saratoga Pas[illegible] through La Conner into Padilla Bay endin[illegible] mi. east of Anacortes. $250,000.

★ †**Wash., Grays Harbor**—June 11, by U. S. Eng., Seattle, reconstructing South Jetty [illegible] entrance to Grays Harbor. $4,000,000.

Que., Anse A Beaufils—June 1, by Secret[illegible] Dpt. P. Wks., Ottawa, reconstructing wh[illegible] $20,000. R. M. Cameron, Ottawa, Ont., engr.

LOW BIDDERS

★ †**Arizona** — Bureau Reclamation, Phoe[illegible] May 16, constructing Bartlett Dam, S[illegible] River Project, from Barrett, Hilp & Ma[illegible] Corp., Clearwater, Calif., $2,228,272. No[illegible] May 6, C. D.—Apr. 23, E. N.-R.

CONTRACTS AWARDED

†**Ariz., Tucson** — U. S. Eng., Los Angel[illegible] Calif., drilling 21 holes at upper and low[illegible] Sabino Canyon Damsites, to Diamond Drill[illegible] Co., 1825 Slauson St., Los Angeles, Calif. $8,110.

★ †**Mont., Fort Peck** — U. S. Eng., Post[illegible] Telegraph Bldg., Kansas City, Mo., placing steel inner-liner in Fort Peck Power Tunn[illegible] to Chicago Bridge & Iron Co., 37 West Van Buren St., Chicago, Ill., $909,961. Est. $1,000,000. Bids Apr. 20, awarded May 18. Noted Apr. 27, C. D.—Mar. 26, E. N.-R.

N. H., Pittsburgh—New Hampshire Water Resources Bd., 14 South Main St., Concord, exploratory drilling at dam and borrow pit areas of proposed reservoir on Connecticut River to Battle Bros., 315 Genet St., Scranton, Pa., $3,700. Bids Apr. 30, awarded May 13. Noted May 11, C. D.—Apr. 23, E. N.-R.

†**South Carolina**—U. S. Eng., Charleston, dredging 780,000 cu.yd. from Intracoastal waterway near McClellanville, to Merritt Dredging Co., 63 Rutledge Ave., Charleston, $44,226. Bids Apr. 14. Noted Apr. 15, C. D.—Apr. 9, E. N.-R.

†**Va., Norfolk**—U. S. Eng., Norfolk, dredging 242,000 cu.yd. in Southern Branch Elizabeth River, to Arundel Corp., Pier 2, Pratt St., Baltimore, Md., $105,270. Bids Apr. 28. Noted Apr. 9, C. D.—Apr. 16, E. N.-R.

★ **Wyo., Cody** — Greybull Valley Irrigation Dist., constructing main canal, Unit 1, to Taggart Constr. Co., Cody, $104,786. Bids Mar. 18. Soon takes bids main dam, diversion dam, structures. Total est. $1,108,000. H. F. Bell, engr.

Ont., Harriston—Municipality, constructing 2 mi. drain for Minto Twp., on Coon Creek, to W. C. Drury, Main St., Arthur. Noted Apr. 2, C. D.—Apr. 9, E. N.-R.

FEDERAL POWER COMMISSION

Applications for License and Permits Licenses

1371 — E. W. Regnier, Union Creek, Ore., wants license constructing power project on Rogue River in Jackson Co., affecting lands in Rogue River Natl. Forest.

1372—Quartz Hill Mining Co., Butte, Mont., wants license constructing transmission line in Beaverhead Co., affecting lands in Beaverhead Natl. Forest.

1373—Utah Power & Light Co., Kearns Bldg., Salt Lake City, Utah, constructing power project on south Willow Creek, Tooele Co., affecting lands in Wasatch Natl. Forest.

UNCLASSIFIED

PROPOSED WORK

Conn., Hartford — HANGAR — City, Airport Comn., Municipal Bldg., plans 1 municipal airport unit to contain 90x135 ft. hangar, 20x100 ft. machine shop and 20x75 ft. work shop, Brainard Field. $114,013. T. M. Foley, P. Wks. Administrator.

†**Mass., Chatham**—BOATHOUSE, etc.—U. S. Coast Guard, Custom House, Boston, making plans constructing 1 story boathouse and launchway, at Coast Guard Station. To exceed $20,000.

N. Y., Brooklyn — WADING POOL — Dpt. Parks, Arsenal Bldg., Central Park, New York, plans by A. Embury, 2nd, archt. and engr., c/o owner, wading pool, drainage system, etc., Red Hook Park, 51-207 Bay St. To exceed $37,000.

N. Y., Yonkers—STEAM CONDUITS—Alexander Smith & Sons, Yonkers, plans constructing steam conduits under Nepperhan Ave. and Orchard St., to connect their steam plant with nearby apartments and residences. $200,000. **Maturity soon.**

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†Federal Government

Unclassified (Continued)

N. Y., Yonkers—TROLLEY TRACKS—Yonkers Railroad Co., Yonkers, will relay trolley tracks in New Main St. Owner received favorable court decision to allow them to lay tracks upper up in 1930. To exceed $23,000. Private plans.

N. C., Wrightsville Sound—WHARF—B. S. Reynolds, Acme, plans extending existing wharf, 500 ft. north of Krafts Wharf, at Wilmington, and adjacent to Inland Waterway. Beaufort to Cape Fear River, about 50x10 ft., driving 4 mooring piles.

O., Cleveland—ARENA—Cleveland Hockey, Inc., A. Sutphin, pres., 1720 East 22nd St., plans by Warner & Mitchell, engrs. and archts., Bulkley Bldg., 1 story 265x265 ft. overall, hockey arena, 85x194 ft., on 3701 Euclid Ave. $300,000. Noted Dec. 19, C. D.—Dec. 26, E. N.-R.

Oklahoma — TRANSMISSION LINES — Oklahoma Gas & Electric Co., 321 North Harvey St., Oklahoma City, made plans constructing 10 mi. transmission line from Edmond to Arcadia, $35,000; and 10 mi. from Enid to Carrier, $18,000. Byllesby Eng. Co., 231 South LaSalle St., Chicago, Ill., engrs.

Okla., Oklahoma City — DUCT SYSTEM — Southwest Bell Telephone Co., Oklahoma City, made plans constructing underground duct system on 1st St. from Hudson to Shartel Sts. $30,000. J. B. Kibler, Oklahoma City, engr.

Okla., Oklahoma City—GAS PIPE LINE—Phillips Petroleum Co., Bartlesville, made plans constructing 16,000 ft. 12 in. wet gas pipe line on Madison St. $45,000. A. H. Riney, Bartlesville, engr.

Pa., Cambridge Springs—GAS DISTRIBUTION LINES—Harry Faber White, Cambridge Springs, plans installation of facilities for distribution of natural gas to consumers throughout borough, incl. 12 mi. pipe line to borough line. To exceed $23,000. Borough Council granted owner franchise. Will apply to Public Service Comn. soon for authority to proceed with project. Private plans.

Wash., Seattle—DOCK—J. M. Colman Co., Colman Bldg., plans reconstructing dock, incl. installing ferry slips on each side and end of pier, shortening pier, installing offices, passenger entrances on each side, general rebuilding. $75,000. A. L. Loveless, 711 Broadway Ave. N., archt.

Wash., Seattle—ISLAND—City, County-City Bldg., plans constructing concrete island in Green Lake to support illuminated fountain. $100,000. T. R. Beeman, County-City Bldg., engr.

B. C., Crofton—WHARF—Empire Lumber Co., Delaware, U.S.A., making plans constructing loading and unloading wharf and trestle approach in Osborn Bay. $35,000.

Ont., North Bay—FISH HATCHERY—Dpt. Game & Fisheries, Toronto, soon takes bids construction fish hatchery and rearing pond in vicinity of Nipissing. $40,000.

Que., Joliette—PARK IMPROVEMENTS—See "Excavation, Drainage, Irrigation and Waterways."

Que., Three Rivers—SWIMMING POOL, etc. —Municipality making plans constructing swimming pool, $100,000; improvements at St. Quentin Island, $50,000; retaining walls on Blvd. des Carmels, $25,000.

BIDS ASKED

Conn., West Hartford (br. Hartford)—SWIMMING POOL—See "Contracts Awarded."

Mass., Hull—PARK—See "Earthwork, Irrigation, Drainage and Waterways."

†**Mass., Chatham**—BOATHOUSE, etc.—June 4, by U. S. Coast Guard, H. G. Hamlet, commander, Custom House, Boston, 1 story, 30x58 ft., frame boathouse on wood piles, 300 ft. timber launchway at Coast Guard Station.

Nebraska — RURAL ELECTRIFICATION — June 5, by Southeastern Nebraska Public Power Dist., Beatrice, constructing 400 mi. rural transmission lines. Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

Okla., Oklahoma City—MUD PIPE LINE—See "Contracts Awarded."

Okla., Oklahoma City — GAS LINE — See "Contracts Awarded."

Pennsylvania — GAS DEVELOPMENT — See "Contracts Awarded."

CONTRACTS AWARDED

Calif., San Francisco—FERRY SLIPS—Public Utilities Comn., City Hall, constructing 3 passenger ferry slips and one freight slip, timber piles, hydraulic machinery to control aprons, etc., on Yerba Buena Shoals in San Francisco, site of 1939 World's Fair, to Healy-Tibbitts Constr. Co., 64 Pine St., $331,600. Est. $457,300. Bids Apr. 29, awarded May 13. Noted May 7, C. D.

Calif., San Francisco—PILE COVERING—Public Utilities Comn., City Hall, for 46,130 lin.ft. P and B process covering untreated piles to be used in connection with ferry slip construction at Yerba Buena Shoals, Shoals Contr. No. 4, to Malott & Peterson, 20th and Harrison Sts., $25,372. Bids Apr. 29, awarded May 13. Noted May 7, C. D.

Conn., West Hartford (br. Hartford)—SWIMMING POOL—Town, R. L. Loomis, mgr., constructing 44x106 ft. rein.-con. swimming pool, and 40x70 ft., brick building, South Quaker Lane, owner builds, **W.P.A.** labor, $30,000. Noted Apr. 16, C. D.—Apr. 23, E. N.-R.

†**D. C., Wash.**—TUNNEL—Treas. Dpt. at office Sup. Archt., Wash., D. C., connecting tunnel between old and new buildings, Interior Department, to Easthom-Melvin Co., 819 Woodward Bldg., $42,612. Bids Mar. 2. Noted May 7, C. D.—Mar. 12, E. N.-R.

†**Me., Winter Harbor**—RADIO STATION—P. Wks. Officer, Navy Yard, Boston, Mass., improving radio station, to Whitaker Corp., Cottage St., Bar Harbor, $2,291. Bids Apr. 23. Noted Apr. 30, C. D.

†**Mass., Nantucket**—BOATHOUSE, etc.—Coast Guard, Custom House, Boston, general contract 1 story, 30x58 ft. boathouse and launchway, Maddaket Coast Guard Station, to James B. Rendle, 230 Meridan St., East Boston, $23,975. Bids May 6. Noted May 12, C. D.

★**New York**—SIGNALLING EQUIPMENT—Bd. Transportation, J. H. Delaney, chn., 250 Hudson St., New York, installing block signalling and interlocking equipment for City-Owned Independent Rapid Transit R.R., to Union Switch & Signal Co., 350 5th Ave., New York, $681,370. Bids Apr. 28. Noted Apr. 29, C. D. —Apr. 16, E. N.-R.

North Carolina — LOGGING RAILROADS — Foreman-Blades Lumber Co., Elizabeth City, J. W. Foreman, pres., constructing 2 logging railroads in Martin Co., one will be between Williamston and Washington, and other between Williamston-Washington Rd. and Route 171. Owner builds.

Ohio—RURAL ELECTRIFICATION—Champaign Co., R. E. Coopr. Assoc., constructing more than 400 mi. rural electrification in Champaign Co., to W. E. Callahan Constr. Co., Dallas, Tex., $407,265. Est. $595,000. Official approval of award must be given by Washington of R.E.A.

Okla., Oklahoma City—GAS LINE—Phillips Petroleum Co., Bartlesville, constructing 8,800 lin.ft. 6 in. high pressure gas line, by company forces. $40,000. A. H. Riney, Bartlesville, engr.

Okla., Oklahoma City—MUD PIPE LINE—Skelly Oil Co., Tulsa, constructing 7,000 lin.ft. 6 in. mud pipe line, 18th and Kate St., company forces. $26,000. J. T. Lovell, Tulsa, engr.

Pennsylvania—GAS DEVELOPMENT—Equitable Gas Co., 435 6th St., Pittsburgh, drilling 10 or more deep wells for development of natural gas field in 6 townships in Greene Co., separate contracts awarded. To exceed $23,000. H. H. Pigott, c/o owners, engr. Owner taking bids for pipe, materials and equipment.

South Carolina — ELECTRIFICATION DISTRIBUTION SYSTEM—State Rural Electrification Authority, 1539 Main St., constructing 147 mi. rural power lines in Aiken, Anderson, Calhoun, Fairfield, Hampton, Lexington, Oconee, Spartanburg, Sumter and Richland Counties, to W. E. Callahan Constr. Co., Kirby Bldg., Dallas, Tex., $104,536. Bids Apr. 27. Noted May 5, C. D.—Jan. 23, E. N.-R.

Wyo., Cheyenne—AIRPORT—City, c/o J. K. Stoddard, clk., additions to and remodeling buildings and altering airport, to T. Cowley, Cheyenne, $17,000. Est. $25,000. Bids Apr. 8.

★†**T. H., Hickman Field**—HANGARS—Con. Q.M., constructing 4 air corps hangars, to R. E. McKee, 108 West 6th St., Los Angeles, Calif., $1,240,000. Bids Apr. 28. Noted May 11, C.D.—Apr. 9, E.N.-R.

MATERIALS AND EQUIPMENT

PROPOSED WORK

†TURBINE, etc.—**Arizona**—Bureau Reclamation, Denver, Colo., rejected bids Mar. 16, 1 vertical-shaft 11,500 hp., 214 r.p.m. hydraulic turbine or new plate steel scroll case, speed ring and draft-tube liner for 11,500 hp. Morgan Smith Co. vertical-shaft hydraulic turbine now installed in Mormon Flat Power Plant, Salt River Project, also 102 in. diam. butterfly valve. Noted Apr. 7, C. D.—Apr. 9, E. N.-R.

STEEL TANKS—**St. Louis, Mo.**—M. C. Early, Wainwright Bldg., applied for permit to install three 1,000 gal. underground steel tanks for gasoline in automobile service station, 2286 South Kingshighway Blvd.

†TRACTORS, etc.—**Omaha, Neb.**—U. S. Eng., 819 City Natl. Bank Bldg., Omaha, soon takes bids furnishing four 50 hp. tractors, gasoline driven, crawler type. $12,000.

GASOLINE STORAGE TANK — **Johnstown, N. Y.**—H. W. Fear, 112 South Kingsboro Ave., Gloversville, plans purchasing 1,000 gal. steel gasoline tank for new proposed service station at corner of North Perry and Canal Sts. To exceed $1,000. W. B. Van Dreser, 31 West Fulton St., Gloversville, engr.

STORAGE TANK — **Norwich, N. Y.** — J. B. Biviano, 40 Brown Ave., plans purchasing 1,000 gal. steel gasoline storage tank for new service station at 36 Brown St. To exceed $1,000. **Maturity at once.**

SEWER PIPE, etc.—**Utica, N. Y.**—Bd. Contr. & Supply, City Hall, Utica, soon takes bids sewer pipe and asphaltic materials for city project.

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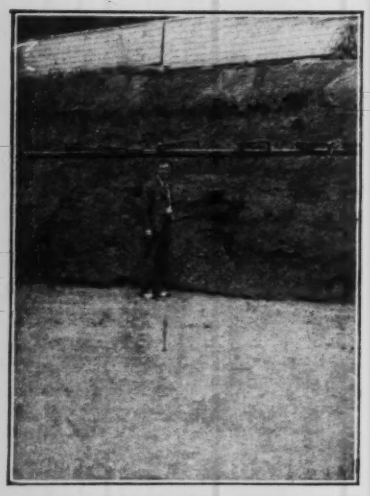
†*Federal Government*



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Materials, etc. (Continued)

BRICK, etc.—**Cleveland, O.**—City soon takes bids 3,000,000 paving brick, 10,000 tons binder stone, oak and pine lumber for bridge repairs.

TILE DRAIN PIPE—**Erie, Pa.**—City, City Hall, A. N. Aitkin, engr., plans purchasing 32,000 lin.ft. tile pipe (various sizes), for W.P.A. project at Port Erie and other projects in city. To exceed $1,000.

TRUCKS—**Nanticoke, Pa.**—Pure Ice Co., W. Samuels, mgr., Nanticoke, plans purchasing 5 motor trucks equipped with bodies suitable for carrying ice for retail delivery. To exceed $1,000.

TANK—**Halifax, N. S.**—Irving Oil Co. Ltd., Plant Wharf, prepares plans 20,000 gal. underground fuel oil tank.

BIDS ASKED

WATER PIPE—**Eureka, Calif.**—City Council taking bids 2,500 lin.ft. 12 in. Class "B" B. and S. or centrifugal cast, c.i. pipe or equal, guaranteed to stand 150 lb. hydrostatic test, delivered f.o.b. dock, Eureka.

TRAVELING CRANES—**Los Angeles, Calif.**—June 19, by Directors Metropolitan Water Dist., F. E. Weymouth, engr., 306 West 3rd St., furnishing two 60 ton traveling cranes for Intake and Gene pumping plants, one 40 ton, for Iron Mountain pumping plant; two 75 ton for Eagle Mountain and Hayfield pumping plants, for Colorado River Aqueduct, Spec. 156. To exceed $70,000.

TRUCK CHASSIS — **Oakland, Calif.** — W. L. Chappell, city clk., taking bids gasoline motor-driven truck chassis, min. 7,000 lbs. and 1 truck body, 14 ft. long behind cab and 8 ft. wide for Street Dpt.

†SHEET IRON or STEEL, etc.—**Wash., D. C.**—June 4, by General Purchasing Officer, Wash., D. C., sheet iron or steel, steel bars, sheet copper, sheet brass, brass rods, copper-nickel alloy, plate zinc, copper pipe and tubing, rigid steel conduit and elbows, wire rope, steel wire, copper wire, insulated wire, antenna wire, magnet wire, electric motors, watt hour meters, transformers, chain hoists, lumber, etc., Schedule 3148.

LIQUID ASPHALT, etc.—**Indianapolis, Ind.**—June 2, by State Hy. Comn., J. D. Adams, chn., Indianapolis, 26,460 gal. liquid asphalt furnished and applied and 5,869 tons rock asphalt to be spread and rolled on 25.53 mi. roads in LaPorte Dist.; 12,030 gal. liquid asphalt, 6,680 tons bituminous concrete binder and 3,007 tons rock asphalt, spread and rolled, on 11.54 mi. road in Greenfield Dist.

†DREDGE PONTOON, etc.—**New Orleans, La.**—June 8, by U. S. Eng., Prytania St. and River Front, constructing and delivering 80 steel dredge pontoons, 22 ft. long and 40 sections 20 in. inside diam. by 50 ft. long steel pontoon pipe.

†GENERATING SETS and PUMP ENGINES—**St. Paul, Minn.**—June 3, by U. S. Eng., 615 Commerce Bldg., St. Paul, 2 or 4 generating sets, and 1 or 2 dredging pump engines, all full Diesel type.

AUTOMOBILE LICENSE PLATES—**Jackson, Miss.**—June 4, by C. N. Craig, state aud., Jackson, automobile license plates, for use by state during year of 1937, for Mississippi State Tax Comn.

GRADER BLADES—**Jackson, Miss.**—June 2, by E. D. Kenna, dir. State Hy. Comn., Jackson, 1 or 2 carloads grader blades, etc., f.o.b. Jackson. $5,000.

†CEMENT UNLOADING EQUIPMENT — **Vicksburg, Miss.**—June 5, by U. S. Eng., P. O. Box 667, equipment for unloading bulk Portland cement from railroad box cars to barges, f.o.b. Greenville.

†SOFTWOOD LUMBER—**Vicksburg, Miss.**—June 16, by U. S. Eng., P. O. Box 665, softwood lumber, delivered at Waterways Experiment Station, Vicksburg.

†STEAM HOIST—**Vicksburg, Miss.**—June 16, by U. S. Eng., Vicksburg, double drum steam hoist without boiler, f.o.b. Vicksburg.

STEAM PUMPS—**Binghamton, N. Y.**—City, C. A. Harrell, city mgr., City Hall, taking bids 2 steam pumps for installation at waterworks (flood control measure). $3,500. J. A. Giles, city engr.

†CABLE—**Brooklyn, N. Y.**—June 2, by Signal Corps Procurement Dist., Army Base, 58th St. and 1st Ave., 4,000 ft. cable and 4 reels for same.

STORAGE TANK—**Watertown, N. Y.**—Standard Oil Co. of New York, taking bids 1,000 gal. steel gasoline storage tank for service station to be built at Main and Leroy Sts. H. Graves, in charge. To exceed $1,000.

SLAG—**Cleveland, O.**—June 2, by Bd. County Comrs., 4,000 tons slag for various store yards, at $1.70 per ton.

SHOVEL — **Mineral City, O.** — Hickory Clay Products Co., in market for steam shovel, with ¾ yd. bucket. To exceed $1,000.

FIRE HOSE—**Catasaqua, Pa.**—June 1, by D. Gillespie, secy. Town Council, 600 ft. 2½ in. double duty fire hose; 200 ft. 1½ in. chemical hose; 6 smoke helmets; 3 first-aid kits; drilling 10 or 12 in. well at borough waterworks. To exceed $1,000.

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AUTOMATIC MILK COOLING MACHINES, etc.—**York, Pa.**—Farmers Organization [illegible] Co., S. Senft, pres. and genl. mgr., in market for automatic milk cooling machines, power-plant equipment and other machinery for installation in milk products plant, East [illegible] North York.

†STACKER and RECLAIMER CONVEYOR—**Knoxville, Tenn.**—June 8, by Tennessee Valley Authority, Knoxville, furnishing, [illegible] radial stacker and reclaimer conveyor [illegible] tersville Dam Plant. C. H. Garrity, [illegible] chases.

STREET PARKING METERS—**San Antonio, Tex.**—City, c/o C. K. Quin, mayor, taking bids furnishing, installing 2,000 street parking meters. $175,000. City Engineering [illegible] engrs. Interested dealers, manufacturers [illegible] should communicate with city at once.

PUMPS, etc.—**Halifax, N. S.**—Dpt. Public Works & Mines, in market for 3 new pumps and transformer for Inverness Coal Mine. $35,000.

LUMBER DOLLIES—**Stewiacke, N. S.**—Canadian Lumber Co. Ltd., in market for [illegible] wheeled lumber dollies.

TANKS—**Brantford, Ont.**—W. E. McLaughlin, Wharf St., in market for two 500 gal. and one 10,000 gal. gasoline tanks.

CONTRACTS AWARDED

†STEEL SHEET PILING—**Arizona**—[illegible] Reclamation, Dpt. Interior, Federal Bldg., Yuma, 1,438,560 lb. steel sheet piling for Imperial Dam, All American Canal, to Jones & Laughlin Steel Co., 3rd Ave. and Ross St., Pittsburgh, Pa., $40,067. Bids Mar. 17.

ASPHALTIC CONCRETE—**Fresno, Calif.**—H. S. Foster, city clk., to Valley Constr. Co., P. O. Box 1349, Fresno, furnishing 1,000 tons asphaltic concrete, 50 tons per day, at $4.50 per ton; 60 tons per day, at $4.35 per ton; over, at $4.20 per ton. Bids Apr. 30. Noted May 15, C. D.

†BUCKET LOADING MACHINES—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., 2 each bucket loading machines, capacity 2 cu.yd. per min., Proposal 644, to Smith-Booth-Upher, 2001 Santa Fe Ave., $5,990. Bids May 11, awarded May 15. Noted May 18, C. D.

CURRENT REGULATING TRANSFORMERS—**Los Angeles, Calif.**—D. P. Nicklin, purch. agt. Dpt. Water & Power, 207 South Broadway, furnishing 13 constant current regulating transformers, Spec. 1953, to Westinghouse Electric & Mfg. Co., 420 South San Pedro St., $4,055. Bids May 8, awarded May 14. Noted May 15, C. D.

†DRAIN TILE, etc.—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., 15,000 lin.ft. drain tile, unglazed 6 in. diam. straight 1 ft. lengths, Proposal 645, to J. S. Wade Co., East Anaheim St., Long Beach, $1,497. Bids May 11, awarded May 13. Noted May 8, C. D.

†FIR TIMBERS—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., furnishing 148,000 bd. ft. Douglas fir timbers, Proposal 605, to Patrick Lumber Co., Terminal Sales Bldg., Portland, Ore., $1,988. Bids Apr. 27. Noted May 15, C.D.

MISCELLANEOUS CUT GLASS—**Los Angeles, Calif.**—D. P. Nicklin, purch, agt, Dpt. Water & Power, 207 South Bway., furnishing miscellaneous cut glass as required during period of 1 year from date of contract, Spec. 1931, to Andrews Hardware & Metal Co., 334 South Main St., $15,000. Bids Apr. 22, awarded May 19. Noted Apr. 16, C.D.

STEEL I-BEAM TUNNEL SETS—**Los Angeles, Calif.**—D. P. Nicklin, purch. agt. Dpt. Water & Power, 207 South Bway., 250 sets 6 in. 12¼ lb. steel I-beam tunnel sets, Spec. 1963, to Bethlehem Steel Co., East Slauson Ave., Vernon, $2,990. Bids May 11, awarded May 12.

†STEEL PIPE—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., 4,000 ft. 3 in. steel pipe, lap-welded black, standard and 10 each 3 in. gate valves, 125 lb. bronze body, Proposal 641, to Pennsylvania Iron & Steel Co., 2308 Santa Fe Ave., $1,444. Bids May 8.

†STEEL SHEET PILING—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., 123 tons steel sheet piling, Proposal 616, to Bethlehem Steel Co., East Slauson Ave., Vernon, $6,680. Est. about $10,000. Bids May 1, awarded May 14.

★ SYNCHRONOUS MOTORS — **Los Angeles, Calif.**—Directors Metropolitan Water Dist., F. E. Weymouth, engr., 306 West 3rd St., furnishing synchronous motors for main line pumping plants for intake and Gene plants, 6 motors, 6,700 kw. output, 9,000 hp. each, f.o.b. Schenectady, N. Y., to General Electric Co., 5201 Santa Fe Ave., $673,552, plus $20,207 tax***furnishing same for Iron Mountain Plant, 3 motors, 3,200 kw. output, 4,300 hp. each, f.o.b. Milwaukee, Wis., to Allis-Chalmers Mfg. Co., 458 South Spring St., $280,000, plus $8,400 tax*** furnishing same for Eagle Mountain and Hayfield Plants, 6 motors, 9,300 kw. output, 12,500 hp. each, f.o.b. Pittsburgh, Pa., to Westinghouse Electric & Mfg. Co., 420 South San Pedro St., $761,711, plus $22,851 tax, all foregoing Spec. 153. Grand total $1,766,721. Bids May 12, awarded May 15. Noted Apr. 20, C. D.—Apr. 23, E. N.-R.

†WATER PUMPS—**Los Angeles, Calif.**—U. S. Eng., 751 South Figueroa St., 4 water pumps,

†*Federal Government*

Materials, etc. (Continued)

Proposal 543, to Pomona Pump Co., 406 South Main St., $15,384. Bids Apr. 15, awarded May 15. Noted Apr. 2, C. D.

WELDING ELECTRODES—**Oakland, Calif.**—J. R. Kimball, secy. East Bay Municipal Utility Dist., 512 16th St., 10,000 lb. electric welding electrodes, Proposal 703, to Harnischfeger Sales Corp., 82 Beale St., San Francisco, $950. Bids May 4, awarded May 15. Noted Apr. 28, C.D.

TIMERS — **San Francisco, Calif.** — T. A. Brooks, city purch. agt., City Hall, furnishing vehicular and pedestrian actuated timers for Dpt. Electricity. Bid 1541, to Automatic Signal Corp., 230 Park Ave., New York, 3 vehicle actuated timers, $374 each; 6 vehicle detectors, 6 ft., $132.60; 8 ft., $149.60; 1 pedestrian actuated timer, $212.50; 3 pedestrian actuated buttons complete with standards, $8.50. Bids Apr. 13. Noted Apr. 6, C. D.

ROAD OIL—**Southgate, Calif.**—City Clerk, 3,716 bbl. road oil, truck and trailer lots, f.o.b. Firestone Blvd. and Atlantic Blvd., various city streets, to Morgan Bros., 5919 Maywood Ave., Huntington Park, $3,529. Est. about $4,000. Bids Apr. 27. Noted May 6, C. D.

BAR SOLDER—**Chicago, Ill.**—Dpt. P. Streets & Electricity, City Hall, furnishing, delivering about 12,000 lb. bar solder and 2,000 lb. wire solder, to City Storeyard, 647 Blue Island Ave., to Eagle Picher Sales Co., 4401 South Western Ave., $3,865. Bids Apr. 23, awarded May 9.

FIR LUMBER, etc.—**Chicago, Ill.**—City, Dpt. P. Wks., 406 City Hall, furnishing, delivering 80,084 ft. B.M. fir and 3,600 ft. B.M. yellow pine lumber, treated with either triolith salts of high fixation, zinc-meta-arsenite or chromated zinc chloride, to Joslyn Mfg. & Supply Co., 20 North Wacker Dr., $5,750. Bids May 1, awarded May 11.

NON-CONDUCTIVE PIPE COVERING—**Chicago, Ill.**—P. Wks., Bureau Eng., City Hall, non-conductive covering for cold water pipes, steam and hot water pipes, boilers, etc., to Asbestos & Magnesia Materials Co., 123 North Peoria Ave., $40,638. Bids May 4, awarded May 9.

VALVE BASIN, etc.—**Chicago, Ill.**—Dpt. P. Wks., City Hall, furnishing, delivering valve basin, vault and tunnel shaft covers and lids for Bureau of Engineering, to various pipe yards, to C. H. Hoppe Fdry. Co., 373 West Grand Ave., $7,779. Bids Apr. 23, awarded May 9.

CULVERT PIPE, etc.—**Allison, Ia.**—Butler Co., 5,082 lin.ft. culvert pipe, to Iowa Concrete Products Co., Ames, $1,382***and to Iowa Culvert & Pipe Co., 444 Insurance Exch. Bldg., Des Moines, $3,880***re-erecting high truss bridge and constructing three I-beam bridges, to Waugh & Tackman, Clarksville, $17,873. Grand total $23,135. Bids May 11. Noted Apr. 28, C. D.—Apr. 30, E. N.-R.

GRAVEL—**Grundy Center, Ia.**—Grundy Co., surfacing 32,250 cu.yd. Class B surfacing, to Concrete Materials Corp., Waterloo, $47,407. Bids May 18. Noted Apr. 21, C. D.—Apr. 23, E. N.-R.

STRUCTURAL STEEL—**Marshalltown, Ia.**—Marshall Co., 46,000 lb. structural steel, to Pittsburgh Des Moines Steel Co., 1015 Tuttle St., Des Moines, $1,871. Bids May 16. Noted May 13, C.D.

WATER PIPE—**Attleboro, Mass.**—City, J. C. Taber, supt. Bd. P. Wks., City Hall, furnishing c.i. water pipe, to Warren Fdry. & Pipe Corp., 75 Federal St., Boston, $48.10 per net ton. Noted May 12, C. D.—May 14, E. N.-R.

PLUMBING SUPPLIES—**Boston, Mass.**—City, Supply Dpt., D. F. Doherty, supt., City Hall Annex, furnishing plumbing supplies, to Sheehan, O'Brien Co., 1 Norwood St., Dorchester, $2,500; garage equipment, to Butts & Ordway, 44 Stanhope St., Boston, $1,002. Bids Apr. 15; furnishing non-asphaltic road oil as required, to Trimount Bituminous Products Co., Everett. Bids Apr. 24. Noted Apr. 20, C.D.

MOTOR GRADER—**Elk River, Minn.**—Sherburne Co., E. M. Darrow, aud., 1 motor grader, to Borchert-Ingersoll, Inc., 2375 University Ave., St. Paul, $3,599. Bids May 7. Noted Apr. 23, C. D.—Apr. 30, E. N.-R.

†ANNEALED STRAND—**Kansas City, Mo.**—U. S. Eng., 232 Exch. Bldg., 210,000 ft. ½ in. galvanized annealed strand, to Macwhyte Co., 2936 14th St., Kenosha, Wis., $3,948. Est. $3,000. Bids May 11, awarded May 12.

†DREDGE PIPE—**St. Louis, Mo.**—U. S. Eng., Custom House, 12th Blvd. and Market Sts., St. Louis, welded steel dredge pipe 20 in. inside diam., delivered to U. S. Eng. Depot, at foot Arsenal St., to Charles Hegewald Corp., 21 State St., New Albany, Ind., $2,147. Bids Apr. 17.

†MACHINE CASTINGS — **St. Louis, Mo.** — U. S. Eng., Custom House, machining upper casing, lower casing and impeller, bolts, etc., on 20 in. Pumps Nos. 14, 15 and 16, machining upper casing, lower casing, suction throat line and impeller bolts, etc., for 24 in. Pump No. 14, U. S. Dredges Ste. Genevieve, Grafton and Dundee, to Fulton Iron Wks. Co., 1259 Delaware Ave., $3,849. Bids Dec. 27.

†PILING—**St. Louis, Mo.**—U. S. Eng., Custom House, 12th Blvd. and Market St., furnishing, delivering 3,000 sticks of piling about 147,300 lin.ft. at Cape Girardeau, to Anderson & Tully, North 2nd St., Memphis, Tenn., $29,686. Bids May 8.

ROAD MATERIAL—**Dutch Neck, N. J.**—West Windsor Twp. Comn., 10,910 gal. tar and asphaltic oil, to Barrett Paving Co., 28 West State St., Trenton, $1,078; 708 tons 3 in. stone and screenings, to R. C. Sanders, Cranbury, $1,619. Bids May 2. Noted Apr. 28, C. D.

PIPE—**Rome, N. Y.**—City, City Hall, c.i. pipe for watermains in East Dominick and Whitesboro Sts., to Charles Millar & Son Co., 501 Main St., Utica, $1,716. **P.W.A.**

STEEL TANKS—**Jamestown, N. Y.**—Sterling Oil Co., Oil City, three 1,000 gal. steel tanks for service station West 3rd and Clinton Sts., to Hammond Iron Wks., Warren. Est. exceeds $1,000. Noted Feb. 14, C.D.—Feb. 20, E.N.-R.

TRACTOR—**Jamestown, N. D.**—Stutsman Co., A. R. Bartel, aud., furnishing 1 crawler type tractor of at least 60 hp. drawbar, to Lewis Tractor & Mchy. Co., Fargo, $4,890. Bids May 4. Noted May 1, C. D.

TRACTOR, etc. — **Allentown, Pa.** — M. W. Gross, mayor, Central Fire & Police Station, tractor for Bureau Parks, to Trexler Farms, P. P. and L. Bldg., Allentown, $879; truck for Bureau of Electricity, to Towne Auto Co., Allentown, $400. Bids May 5. Noted Apr. 30, C. D.

GRAVEL—**Hartland, Wis.**—Town, 5,000 to 6,000 cu.yd. crushed gravel, to J. Reinke, Bonduel. Bids May 4. Noted Apr. 21, C. D.—Apr. 23, E. N.-R.

STEEL — **Milwaukee, Wis.** — Milwaukee Co. Hy. Dpt., W. F. Cavanaugh, comr., reinforcing steel, to Bethlehem Steel Co., 212 West Wisconsin Ave., $3,334. Bids May 15.

CEMENT, etc.—**Sheboygan, Wis.**—City, 6,000 bbl. cement, contract divided among seven local contractors at $2.74 per bbl. Bids Apr. 17. Rejected bids Apr. 17, 4,000 tons coarse and 3,000 tons fine aggregate.

POWER MAINTAINER — **North Dumfries Twp., Ont.**—H. C. Elliott, clk., R. R. of Galt, power maintainer for township roads, to Sawyer-Massey Ltd., Wellington St., Hamilton, $3,250.

CEMENT—**Peterborough, Ont.**—City, cement, to T. A. Rehill, 210 Wolfe St., $2.40 per bbl., f.o.b. city yard, $2.50 per bbl. in company's yard. Noted Apr. 28, C. D.

PIPE — **St. Thomas, Ont.** — Public Utilities Comn., 717 Talbot St., 5,000 ft. 6 in. c.i. meter pipe, to Canada Iron Foundries, 1000 Talbot St. Est. $10,000.

TRUCK—**St. Thomas, Ont.**—City, 7 ton heavy duty gravel dump body truck, to E. G. Ponsford, 9 William St. Est. $3,500. Noted May 5, C. D. —May 7, E. N.-R.

CHLORINATOR—**St. Johns, Que.**—Municipality, furnishing chlorinator, to Wallace & Tiernan Ltd., Toronto, Ont. Noted Mar. 26, C. D. —Apr. 2, E. N.-R.

FOREIGN

Africa, Ethiopia and Eritrea—Italian Government, Rome, Italy, plans constructing 1,750 mi. paved highway, incl. 310 mi. highway from Assab Eritrea to Dessye, Ethiopia; and 527 mi. highway to connect Adigrat and Dessye with Addis Ababa, Ethiopia.

Australia, Melbourne—July 27, by City Clerk, supplying indicating and recording instruments for Spencer St. and Waratah Pl. electrical stations.

England—London, June 10, by Islington Borough Engineer, 60 Edengrove Holloway, supplying steel lamp columns, small emergency battery, fire resisting apparatus, in connection with new switchgear and for 5,000 kva. 6,600 volt 3 phase, to 2,200 volt single phase Scott-connected transformers. **London***T. C. Wild Ltd., Freedom Wks., John St., **Sheffield,** in market for 500/750 hp. a/c motor, 440 or 2,200 volts, 243 r.p.m., also for 80 hp. 400/3/50, 950 r.p.m. slip ring motor with starting gear, also for 130 hp. 220 volts, d/c 325 r.p.m. shunt or compound wound motor***J. Thompson Ltd., 290 Vauxhall Rd., **Liverpool,** in market for 3 ton hand derrick crane also for 6½ hp. hopper cooled engine***Birkenhead** Municipality supplying two 750 kw. mercury-vapor rectifiers, to Hewittic Electric Co. Ltd., Walton-upon-Thames, $34,900.

U. S. S. R., Moscow—Union Socialist Soviet Republics, Moscow, or c/o Amtorg Trading Corp., 265 5th Ave., New York, equipment for 2 steel mills, to Lewis Foundry & Machine Co., Groveton, Pittsburgh, Pa.

Wales, Llanelly—J. and P. Zammit Ltd., in market for 10 ton steam locomotive crane with lattice steel gib, 35 ft. long.

PUBLIC BUILDINGS

PROPOSED WORK

Calif., Anaheim—Anaheim Elementary School Dist., defeated $325,000 bonds for schools. Est. $487,520. Marsh, Smith & Powell, 816 West 5th St., Los Angeles, archts. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

Calif., El Centro—El Centro City, election May 25, $100,000 bonds for city hall and library. Total est. $175,000. $75,000 to be furnished by PWA. Architect not appointed. Noted June 19, C.D.—June 27, E.N.-R.

†*Federal Government*

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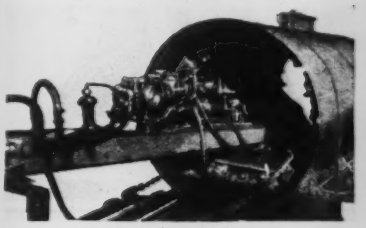
BUILD SEWERS IN TUNNEL



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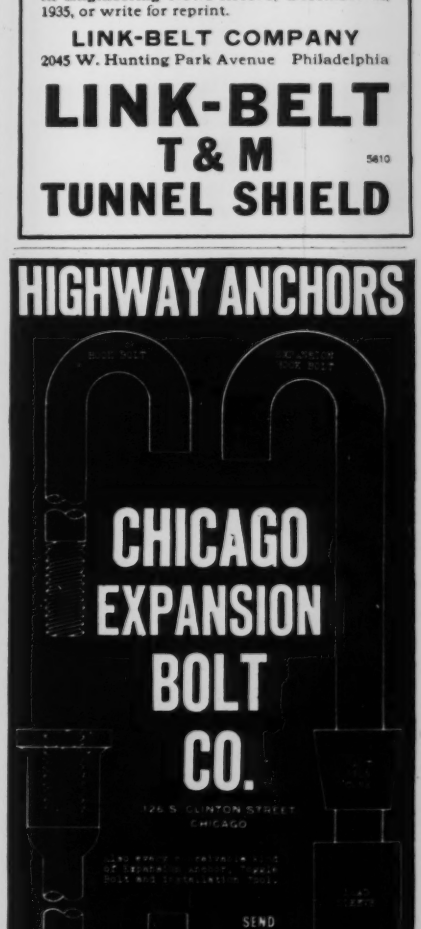

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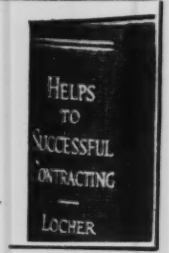

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Public Buildings (Continued)

Calif., Livermore—Alameda Co., Oakland, plans by W. G. Corlett, Bank of America Bldg., Oakland, rein.-con. Class "A" dormitory, $150,000.

†Calif., Sacramento — Treas. Dpt. at office Sup. Archt., Wash., D. C., plans by Starks & Flanders, Bank of America Bldg., Sacramento, 2 story, Class "A" federal building addition, $100,000.

†Colo., San Isabel—U. S. Forest Service, Denver, Colo., plans rustic hotel, near here, $200,000.

Me., Washburn—Town, A. A. Woodworth, chn. School Bd., plans by J. C. Le Vasseur, North Main St., Presque Isle, high school. To exceed $140,000. **Maturity indefinite.**

Mass., Harwichport—Town, R. H. Doane, chn. School Com., Town Hall, plans by H. R. Duffie, 110 Bellevue St., West Roxbury, brick, stone, steel Junior and Senior High School. Est. about $140,000. Noted Jan. 29, C.D.—Feb. 6, E.N.-R.

Mo., Fulton—State Hospital 1, Fulton, and Bi-Partisan Advisory Bd., State Building Comm., E. M. Eazan, executive secy., Jefferson City, soon takes bids constructing 5 story, basement, rein.-con., brick, stone psychiatric clinic. P.W.A. project. P. J. Bradshaw, Inc., 718 Locust St., St. Louis, archts.

N. J., Hackensack—Hackensack Hospital, 3rd St., constructing hospital addition, to Wigton-Abbott Corp., 143 Liberty St., New York. Crow, Lewis & Wick, 200 5th Ave., New York, archts.

N. Y., Bradford—Bd. Educ., Dist. 1, bids in June constructing school. P.W.A. project. Bids May 11 rejected. R. A. Freeburg, 1105 West 3rd St., Jamestown, archt. Noted May 18, C.D.—May 7, E.N.-R.

N. Y., Glen Cove—Bd. Educ. deferred plans for constructing high school. Noted Dec. 2, C. D.—Dec. 5, E. N.-R.

N. Y., New York—Dpt. Hospitals, 125 Worth St., New York, plans by R. D. Kohn, 56 West 45th St., constructing Metropolitan Hospital addition, Welfare Island. To exceed $140,000. Bids after June 1, on foundations.

N. Y., New York—Dpt. Parks, Arsenal Bldg., Central Park, plans by A. Embury, 2nd, c/o owner, 1 story, 89x188 ft. cafeteria, Randalls Island. $150,000.

N. Y., Syracuse—Bd. Educ., R. D. Marvin, mayor, City Hall, plans constructing additions to Edward Smith and Charles Andrews Schools, $200,000. Architect and engineer not appointed.

N. Y., Vestal—Central School Dist., c/o K. E. Beilby, dist. supt. schools, will vote on centralization of 14 districts for constructing school. To exceed $150,000. Architect and engineer not appointed.

N. Y., Wyoming — Central School Dist. 2, plans by R. E. Pfohl, 204 West Huron St., Buffalo, constructing brick, steel central school, plain found. To exceed $140,000. Election June 2 to select site. Noted Jan. 30, C. D.—Feb. 6, E. N.-R.

N. Y., Yonkers—Bd. Educ., City Hall, plans addition to School 21. To exceed $140,000. Architect and engineer **not appointed.**

O., Chillicothe—Voters of Southeastern Rural School Dist. rejected $200,000 school construction bond issue. Noted Apr. 20, C. D.—Apr. 23, E. N.-R.

★**Pa., Johnstown**—Johnstown School Dist., G. R. Hunter, secy., plans by H. M. Rogers, Johnstown, $1,000,000 building program, incl. addition to Joseph Johns School est. $400,000 to $500,000; administration building on Adams St.; cafeteria-classroom addition to Cochran Junior High School; new units at Horner, Dibert, Union and Chestnut Schools. P.W.A. project.

†S. C., Columbia—P. Wks. Administration, Housing Div., Wash., D. C., received no bids May 15, constructing superstructure Columbia Terrace Housing Project, Project H-5201. An Addendum will be issued for extension of time. Noted Apr. 21, C. D.—Apr. 23, E. N.-R.

Tex., San Antonio—Bd. Educ., Lavaca and Water Sts., revised plans by Phelps & De Wees, Gunter Bldg., new brick, rein.-con. auditorium, plain found., 2,500 seating capacity. $150,000. P.W.A. project.

†Utah, St. George—Treas. Dpt. at office Sup. Archt., Wash., D. C., rejected bids May 8, constructing U. S. Post Office. Will revise plans and readvertise. Noted May 12, C. D.—Apr. 16, E. N.-R.

Wyo., Greybull—Greybull High School Dist. 1, [illegible] bonds for high school, $163,000 [illegible] Tohagen, Hedden Bldg., Billings, Mont., archt.

N. S., Halifax—Provincial Govt., Hon. A. L. MacDonald, minister, bids this month for addition to legislature building, $185,000; also forest fire fighting equipment, $20,375 voted, limestone equipment, $13,000 voted.

BIDS ASKED

†Mass., Boston—June 3 (extended date), by P. Wks. Administration, Div. Housing, Wash., D. C., constructing superstructures of Old Harbor Village Housing Project, Project H-3302, Old Colony Ave. Noted May 1, C. D.—M[illegible] E. N.-R.

†Mass., North Turo—June 2, by P. Wk[illegible] cer, Navy Yard, Boston, constructing 2 [illegible] basement, 33x24 ft., timber barracks b[illegible] timber garage, heating, plumbing, electri[illegible] system, pump house at Naval Direction [illegible] Station.

†Mo., Jefferson Barracks—June 9, by V[illegible] Administration, Arlington Bldg., Wash., [illegible] furnishing, installing 1 electric passeng[illegible] vator in Building 25 of Veterans Administ[illegible] Facility.

Mo., Rolla—June 2, by Missouri Sch[illegible] of Mines & Metallurgy, Rolla and Curato[illegible] of University of Missouri, L. Cowan, secy., [illegible] Hall, Columbia, constructing 1 story, [illegible] concrete hospital addition. P.W.A. project. Jamieson & Spearl, 1116 Arcade Bldg., St. Louis, archts.

†Mo., St. Louis—June 2, by Treas. Dpt. at office Sup. Archt., Wash., D. C., furnishing, installing interior lighting fixtures in [illegible] rooms of U. S. Court House and Custom H[illegible] 12th Blvd. and Market St.

Me., Pownal—State, S. E. Vosburgh, Supt. State Schools, bids about June 1, 2 story, basement, brick, steel laundry building addition, concrete found., at State School. Coombs & Harriman, 11 Lisbon St., Lewiston, archts. Fels Co., 42 Union St., Portland, engrs.

Mo., Thayer—June 10, by City, C. A. R[illegible] mayor, general contract remodeling municipal light and power plant, incl. concrete work, cooling tower and oil storage tank. Sect. 1: Diesel engine generator units with all auxiliaries. Sect. 2: electric distribution system and street lighting. Sect. 3. $72,738. P.W.A. project. Bids May 14 rejected. W. A. Fuller Co., 2026 Shenandoah Ave., St. Louis, engrs. Noted Apr. 27, C. D.—Apr. 30, E. N.-R.

†Md., Bethesda—June 18, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing animal laboratory building at U. S. Public Health Service. $100,000.

†Mass., North Scituate—June 2, by U. S. Coast Headquarters, Wash., D. C., 2 story, basement, 32x46 ft. dwelling with 15x17 ft. wings and 28x45 ft. garage at Coast Guard Station. $35,000.

Mo., St. Louis—June 9, by Bd. P. Serv., City Hall, constructing 2 story, basement superstructure for colored community building, Market St. at Compton Ave. $70,000. P.W.A. project. A. Osburg, city archt. W. C. E. Becker, city engr. Noted May 15, C.D.—May 21, E.N.-R.

†Neb., Fremont—June 19, by Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing, extending and remodeling U. S. Post Office, $100,000.

N. Y., Batavia—June 11, by Dpt. Educ., Education Bldg., heating work, boilers, boiler apparatus at New York State School for Blind.

N. Y., Brooklyn—See "Contracts Awarded."

N. Y., Brooklyn—June 10, by Dpt. Mental Hygiene, State Office Bldg., Albany, construction, heating, electrical work, sanitary work, special electric fixtures, for Brooklyn State Hospital. $200,000.

†N. Y., Flushing—June 17, by U. S. Eng. Army, Bldg., 39 Whitehall St., New York, dredging 162,558 cu.yd. in harbor, Flushing Bay.

N. Y., Newark—June 24, by Dpt. Mental Hygiene, State Office Bldg., Albany, constructing additional work at Newark State School.

N. Y., Orangeburg—June 24 (extended date), Dpt. Mental Hygiene, State Office Bldg., Albany, construction, heating, sanitary, electrical work, special electric fixtures, elevator, dumbwaiter service connections connecting corridors power plant facilities at Rockland State Hospital. $200,000. Noted Apr. 24, C.D.—Apr. 30, E.N.-R.

N. Y., Ossining—June 11, by Dpt. Correction, State Office Bldg., Albany, miscellaneous additional work at power house, Sing Sing Prison.

N. Y., Rome — June 10, by Dpt. Mental Hygiene, State Office Bldg., Albany, constructing work in engine room, power plant, etc., and electrical work for power plant, equipment and electrical service connections at Rome State School.

N. Y., Warwick—June 25 (extended date) by Dpt. Social Welfare, State Office Bldg., Albany, miscellaneous additional **work at New** York State Training School for Boys. Noted Apr. 24, C.D.—Apr. 30, E.N.-R.

†N. Y., West Point—June 15, by Con. Q.M., United States Military Academy, West Point, constructing 1 cadet barracks and academic building; adv. E.N.-R., May 28. Noted Feb. 24, C. D.—Feb. 27, **E. N.-R.**

N. Y., Wingdale—June 17, by Dpt. Mental Hygiene, State Office Bldg., Albany, constructing assembly hall, at Harlem Valley State Hospital.

†O., Toledo—June 12, by P. Wks. Administration, Housing Div., Wash., D. C., foundations of Belmont Division Housing Project, Project 2601. Noted Feb. 14, C. D.—Feb. 20, E. N.-R.

†Okla., Muskogee—June 23, by Dpt. Indian Affairs, Interior Dpt., Wash., D. C., constructing

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†Federal Government

Public Buildings (Continued)

additional buildings and utilities Hospital 1. Noted Nov. 4, C. D.—Nov. 7, E. N.-R.

†**Tenn., Memphis**—June 12 (extended date), by P. Wks. Administration, Div. Housing, Wash., D. C., constructing superstructures of Dixie Homes Project. Project H-3401. Noted May 1, C. D.—May 7, E. N.-R.

†**Tenn., Nashville**—June 5, (extended date), by P. Wks. Administration, Div. Housing, Wash., D. C., constructing superstructures of Cheatham Place Housing Project, Project H-2101. Noted May 1, C. D.—May 7, E. N.-R.

†**Tex., Dallas**—June 11, by P. Wks. Administration, Div. Housing, Wash., D. C., constructing superstructure for Lucas Drive Housing Project. Noted Dec. 17, C. D.—Dec. 26, E. N.-R.

†**Wyo., Cheyenne**—June 23, by Treas Dpt. at office Sup. Archt., Wash., D. C., constructing additional stories to U. S. Post Office. $95,000. Noted Jan. 30, C. D.—Feb. 6, E. N.-R.

Alta., Edmonton—A. Ritchie, supt. in charge of power plants, taking bids 15,000 kw.-hr. turbo-generator, 20,000 kw.-hr. unit, for City Council. $200,000. Noted June 24, C. D.—June 27, E. N.-R.

Ont., Ottawa—L. LeBlanc, archt., Rideau St., taking bids faculty hall on Clegg and Main Sts., for Ottawa University, Laurier Ave. E. $100,000 first unit.

CONTRACTS AWARDED

†**Ala., Ozark** — Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. Blair, Montgomery, $49,025. Bids May 1. Noted May 5, C. D.—Apr. 16, E. N.-R.

†**Ark., Springdale**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to Linebarger & Fraser, Springdale, $49,000. Bids May 5. Noted May 7, C. D.—Apr. 16, E. N.-R.

Calif., San Francisco — O. Monson, general contractor, 475 6th St., iron work for school machine shops, Fillmore and Bay Sts., to Fair Mfg. Co., 617 Bryant St., for Dpt. P. Wks., City Hall•••sheet metal, to Fire Protection Products Co., 1101 16th St.•••metal lockers, to Trask & Squires, 39 Natoma St.•••steel sash and doors, to Detroit Steel Products Co., 111 Sutter St.•••laminite floors, to Royal Floor & Linoleum Co., 1930 Van Ness Ave.•••shop blowers, to Rees Blow Pipe Co., 340 7th St.•••marble, to J. E. Back Co., 1533 San Bruno Ave.•••tile, to Art Tile & Mantle Co., 221 Oak St.•••roofing, dampproofing and waterproofing, to Malott & Peterson, 20th and Harrison Sts.•••hollow metal doors, to Price Bldg. Specialties Co., 683 Howard St.•••acoustical work, to Western Asbestos Co., 675 Townsend St.•••finish hardware, to Palace Hardware Co., 581 Market St.•••painting, to R. P. Paolin, 2530 Lombard St.•••lathing and plastering, to M. J. King, 231 Franklin St. Noted May 15, C. D.—May 21, E. N.-R., under "Contracts Awarded."

Conn., New London—A. F. Peaslee, Inc., general contractors, 15 Lewis St., Hartford, excavating for brick, steel dormitory, to F. Onuparik, Uncasville, for Connecticut College for Women, K. Blunt, pres.•••structural steel, to Standard Structural Steel Co., 1014 Wethersfield Ave., Hartford•••reinforcing steel, to Scherer Steel Co., Inc., High and Allyn Sts., Hartford•••roofing, to Union Sheet Metal Wks., New London•••waterproofing, dampproofing, to Union Sheet Metal Wks., New London•••stone, to Indiana Limestone Co., Bedford, Ind., and Bottinelli Monumental Co., 581 Broad St., New London. Noted Apr. 16, C. D.—Apr. 23, E. N.-R., under "Contracts Awarded."

★†**D. C., Wash.**—Treas. Dpt. at office Sup. Archt., Wash., D. C., archives building, metal stacks-filing equipment, etc., to Snead & Co., 96 Pine St., Jersey City, N. J., $1,385,900. Bids May 20. Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

★**Fla., Orlando**—M. R. Watson, dir. State Institution Buildings, new tuberculosis hospital, in vicinity of here, to Langston & Murphy, Inc., Orlando, $515,000. **P.W.A.** Noted May 4, C. D.—May 7, E. N.-R.

†**Ga., Brunswick**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing dwelling, garage and accessories, St. Simons Island, to Windsor Constr. Co., Brunswick, $48,515. Bids Apr. 23. Noted Apr. 14, C. D.—Apr. 16, E. N.-R.

Ga., Milledgeville—State Bd. Control, E. E. Lindsay, chn., constructing central heating plant units. Contr. 1, to Grinnell Co., 249 North Highland Ave., Atlanta, $114,000•••Contr. 2, to Moore-Broache Eng. Co., Atlanta Title & Trust Co. Bldg., Atlanta, $5,585•••Contr. 3, to Babcock-Wilcox Co., Chandler Bldg., Atlanta, $39,463•••Contr. 4, to Detroit Stoker Co., 5-127 General Motors Bldg., Detroit, Mich., $18,126 •••Contr. 5, to J. A. Dodd Co., 101 Marietta St. N.W., Atlanta, $2,000; Contr. 6, to Fairbanks-Morse Co., 515 Whitehall St. S.W., Atlanta, $1,470•••Contr. 7, to Crawford & Slaten Co., 820 Woodrow St. S.W., Atlanta, $59,987••• Contr. 9, to Elliott Co., Jeannette, Pa., $3,520. Grand total $244,153. Awards made subject to **P.W.A.** approval. Bids Apr. 17. Noted Apr. 29, C. D.—Apr. 23, E. N.-R.

†**Idaho, Idaho Falls**—Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Post Office, to C. Berntson, 1180 Warnock Ave., Salt Lake City, Utah, $84,694. Bids Apr. 30. Noted May 5, C. D.—Apr. 2, E. N.-R.

†**Ia., Muscatine**—Treas. Dpt. at office Sup. Archt., Wash., D. C., extending and remodeling U. S. Post Office, to James I. Barnes, Logansport, Ind., $98,840. Bids May 14. Noted May 5, C. D.—Apr. 30, E. N.-R.

Kan., Wichita—Municipal University Wichita, R. W. Elliott, comptroller, general contract, incl. plumbing, heating, ventilating, electrical work for construction 2 story auditorium and commons building, to Hahner & Foreman, Wichita, $183,527. Takes bids later on lighting fixtures, equipment. Est. $221,000 with equipment. G. H. Thomas, 125½ North Topeka St., archt.

†**La., Winnsboro**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. Blair, 1st Natl. Bank Bldg., Montgomery, Ala., $45,790. Bids Apr. 30. Noted May 5, C. D.—Apr. 9, E. N.-R.

Me., Brunswick—D'Amore Constr. Co., general contractors, 89 State St., Boston, Mass., heating for Senior High School, for Town, E. W. Booker, town clk., 1st Natl. Bank Bldg., to The Fels Co., 42 Union St., Portland••• plumbing, to Scribner & Iverson, 69 Union St., Portland•••electrical work, to Kerr Electric Co., Inc., 44 Fern St., Auburn. Noted May 11, C. D.—May 14, E. N.-R., under "Contracts Awarded."

†**Md., Salisbury**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to Seymour Huff & Sons, 2133 Maryland Ave., Baltimore, $112,500. Bids May 7. Noted May 11, C. D.—Apr. 16, E. N.-R.

†**Mass., Bedford**—Vet. Bu., Arlington Bldg., Wash., D. C., sand fillers for hospital building additions, to J. Bowen Co., 129 Newberry St., Boston, $20,000; constructing additional buildings, to Thomas O'Connor Co., 238 Main St., Cambridge, $455,772.

†**Mass., Cambridge**—P. Wks. Administration, 21st and C Sts., Wash., D. C., constructing foundations for Main Street Housing Project, Project H-5801, to M. Spinelli & Sons, 38 Chauncy St., Boston, $64,400. Bids Apr. 21. Noted Apr. 24, C. D.—Apr. 16, E. N.-R.

Mass., Lowell—Aberthaw Co., general contractors, 80 Federal St., Boston, plumbing for addition to Lowell General Hospital, to James A. Cotter Co., 334 Shawmut Ave., Boston, for Lowell General Hospital, 339 Varnum Ave.; structural steel and iron, to Lehigh Structural Steel Co., 77 Franklin St., Boston. Noted May 14, C.D.—May 14, E.N.-R., under "Contracts Awarded."

†**Mass., Nantucket**—Koslow & Ritchie, general contractors, 7 Davis Sq., Somerville, painting for garage, boathouse and workshop for Coskata Coast Guard Station, for U. S. Coast Guard, Custom House, Boston, to H. J. Cassidy, 46 Rawson Rd., Arlington; structural steel and iron, to Groisser & Shlanger Iron Wks., 84 Washington St., Somerville. Noted Apr. 23, C. D.—Apr. 30, E. N.-R.

Mass., Norwell—Town, Building Comn., Town Hall, general contract 3 story, 57x190 ft., brick, steel high school, to I. P. Rocheford, 8 Arlington Pl., Framingham•••electrical work, to Barnes-Pope Co., 98 Brookline Ave., Boston••• plumbing, to James S. Cassedy, Inc., 133 Austin St., Cambridge•••heating, to George A. Beach, Central St. Noted Apr. 23, C. D.—Jan. 23 E. N.-R.

†**Minn., Minneapolis** — Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to H. M. Leighton Co., 716 South 7th St., $199,208. Bids Apr. 28. Noted May 1, C. D.—Apr. 9, E. N.-R.

★**Mo., St. Louis**—City, Bd. P. Service, City Hall, general contract 2 story, part basement, 89x191 ft. superstructure for Soldiers Memorial Building, to H. B. Deal & Co., Inc., 1218 Olive St., $548,374, under Alternate 1 providing for cut stone at quarry Bedford, Ind. **P.W.A.** Bids May 1. Noted May 12, C.D.—Apr. 16, E.N.-R.

†**N. H., Portsmouth**—P. Wks. Officer, Navy Yard, passenger elevator additions in Building H-1, at U. S. Naval Hospital, Spec. 8136, to Portland Elevator Co., 133 Oliver St., Boston, Mass., $4,809. Bids Apr. 29. Awarded May 12. Noted May 8, C. D.—Apr. 16, E. N.-R.

N. Y., Copenhagen—Bd. Educ., general contract school, to Deline Constr. Co., Mill St., Watertown, $189,500. Subject to **P.W.A.** approval. General contractor awarded contract for reinforcing steel and steel joists, to Bethlehem Steel Co., Bethlehem, Pa. Award subject to **P.W.A.** approval. Noted Mar. 27, C.D.—Apr. 30, E.N.-R.

N. Y., Dannemora—Amsterdam Building Co., general contractors, 110 East 42nd St., New York, reinforcing steel for administration building for Dpt. Correction, State Office Bldg., Albany, to Milton Steel Co., Milton, Pa.; structural steel, to Belmont Iron Wks., Eddystone, Pa. Noted Apr. 10, C.D.—Apr. 16, E.N.-R., under "Contracts Awarded."

†*Federal Government*

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LUFKIN

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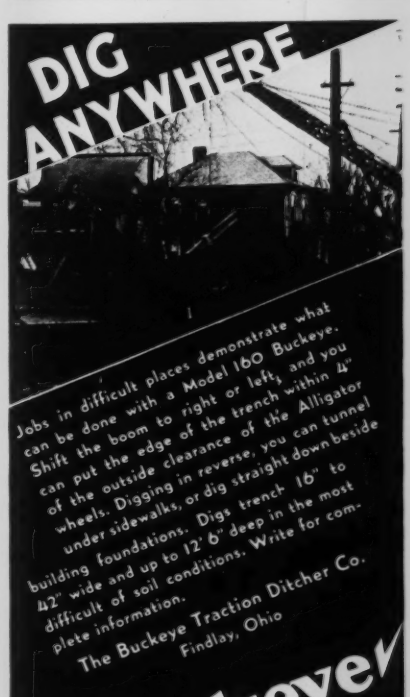
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Public Buildings (Continued)

N. Y., New Berlin—Central School Dist. 1, general contract brick, steel school, plain found., Main St., to T. C. Brown Co., Inc., 307 Union St., Schenectady. Est. $286,000. **P.W.A. Bids** May 6. Noted May 8. C.D.—Apr. 23. E.N.-R.

N. Y., Pavilion—Bd. Educ., Central School Dist. 1, general contract school, to B. Rebescher & Sons, 110 **Timon St., Buffalo. Est.** $243,000. Subject to **P.W.A.** approval. Noted May 13. C.D.—Apr. 30, E.N.-R.

N. Y., Rome—Bevan Constr. Co., general contractors, 3566 East Genesee St., millwork for hospital, Floyd Ave., for Oneida County Hospital, Rome to Denton-Waterbury, 45 Clinton St., Utica; glazing, to Pittsburgh Plate Glass Co., 615 Eagle St., Utica. **P.W.A.** Noted May 8. C.D.—May 14, E.N.-R., under "Contracts Awarded."

†**N. Y., Troy** — Treas. Dpt. at office Sup. Archt., Wash., D. C., demolition and constructing U. S. Post Office, to A. J. Paretta Contr. Co., 43 45th St., Long Island City. $260,700. Bids Mar. 27. Noted Apr. 1. C. D.—Mar. 5. E. N.-R.

†**N. Y., Troy** — Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing freight elevator in U. S. Post Office, to Warsaw Elevator Co., 220 South Main St., Warsaw. $3,277. Bids Apr. 6. Noted Apr. 9. C. D.—Mar. 26. E. N.-R.

†**N. Y., Walton**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to Loucks & Clarke Corp., Wallingford, Conn., $62,467. Bids Apr. 17. Noted Apr. 21. C. D.—Mar. 19. E. N.-R.

R. I., Howard (Cranston)—Henry M. Soule, general contractors, 110 Brook St., Pawtucket, heating in connection with remodeling "C" building at Mental Hospital, to Lincoln & Lane Co., 30 Bayley St., Pawtucket, for State Emergency P. Wks. Comn., State House, Providence ***plumbing, to Wm. D. Fortin, Inc., 888 Main St., Pawtucket***electrical work, to N. E. Machine & Electric Co., 77 Bayley St., Pawtucket ***reinforcing steel, to Tuscon Steel Co., 87 Weybosset St., Providence. **P.W.A.** Noted Feb. 7. C. D.—Feb. 13. E. N.-R., under "Contracts Awarded."

R. I., Providence—Tucker Constr. Co., general contractors, 346 Washington St., limestone for Senior High School, Mt. Pleasant Ave., for City, Bd. Contr. & Supply, City Hall, to Heltonville Limestone Co., Bedford, Ind.***marble, to New England Marble Co., 12 Dixwell St.*** water and dampproofing, to Pneumatic Concrete Corp., 348 Wash. St.***reinforcing steel, to Concrete Steel Co., 294 Wash. St., Boston, Mass.***steel and iron, to Bethlehem Fabricators, Inc., Bethlehem, Pa.***painting, to E. F. O'Donnell, 18 Stokes St.***tile, to Freeport Tile & Marble, 264 Adams St., Dorchester, Mass.***granite, to Providence Granite Co., 210 Kingsley Ave. Noted Jan. 8. C. D.—Jan. 16. E. N.-R., under "Contracts Awarded."

Tex., Anahuac—Chambers Co., c/o G. S. Jackson, Jr., judge, general contract superstructure for 3 story, 70x145 ft., stone, rein.-con. court house, to R. E. McKee, El Paso. $158,280. Awarded May 12. **P.W.A.** Noted Sept. 11. C. D.—Sept. 19. E. N.-R.

†**Tex., Conroe** — Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. F. Blair, Petersburg, Va., $50,565. Bids May 1. Noted May 5. C. D.—Apr. 6. E. N.-R.

Tex., Fort Worth—City, c/o G. D. Fairtrace, mgr., (a) plumbing work (b) electrical work for (1) cattle exhibit building (2) show horse building (3) rodeo horse and rodeo livestock building, to Schmidt-Garretson. (a1) $6,196 (a2) $2,287 (a3) $975***to Ashe Electric Co., 505 Jones St., (b1) $2,459 (b3) $1,495***to Goolsby Electric Co., 1113 Cherry St. (b2) $1,102. Grand total $14,514. Subject to **P.W.A.** approval. Bids Apr. 29.

†**Tex., Kaufman**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. Blair, 1st Natl. Bank Bldg., Montgomery, Ala., $52,974. Bids Apr. 21. Noted Apr. 24. C. D.—Mar. 26. E. N.-R.

†**Tex., LaGrange**—Treas. Dpt. at office Sup. Archt., Wash., D. C., constructing U. S. Post Office, to A. Blair, 1st Natl. Bank Bldg., Montgomery, Ala., $54,229. Bids May 1. Noted May 14. C. D.—Apr. 9. E. N.-R.

COMMERCIAL BUILDINGS

PROPOSED WORK

Ariz., Phoenix—Maricopa Stake Church of Jesus Christ of Latter Day Saints, Phoenix, plans by L. S. Anderson, Phoenix, constructing church $800,000, and reception center $50,000.

Calif., Santa Monica—**Y.M.C.A., 107 Santa** Monica Blvd., R. C. Tidall, executive secy., plans new 150x150 ft. Y.M.C.A. building, incl. gymnasium, swimming pool, offices and 50 to 100 dormitory rooms. $150,000. Architect not appointed.

Conn., Bridgeport—Motorways Hotel Co., **W. J. Eastman, trustee, 28 Fairfield Ave., plans** being completed by E. B. Caldwell, 1029 Fairfield Ave., and takes bids in July for 4 story, 80x160 ft., brick, steel, terra cotta hotel, office, and stores building, 4 stores, 2,500 sq.ft. offices. Water and Fairfield Sts. $250,000. Noted Feb. 21. C.D.—Feb. 27. E.N.-R.

Conn., Fairfield—Brooklawn Park Hills Co., E. W. Jr. and M. M. Bassick, c/o E. G. Southey, archt., 955 Main St., Bridgeport, making plans 30 residences all on 1 acre plots, Algonquin Rd. To exceed $150,000. C. D. Lay, landscape archt.

Conn., Sherman—Robert E. Farley Organization, 2 Martine Ave., White Plains, N. Y., plans tract development, 1,200 acres and log cabin dwellings, Mattakeunk Colony, $140,000. Site acquired.

Mass., Cambridge—Society of St. John the Evangelist, Memorial Dr., rejected bids May 6, 3 story, basement, 46x135 ft., brick, stone, granite church and monastery, concrete found. Memorial Dr. To exceed $150,000. Will readvertise. Buerkel & Co., Inc., 24 Union Park, Boston, engrs. Noted Apr. 28, C.D.—Apr. 30, E.N.-R.

N. J., Morristown—Suburban National, Inc., c/o A. E. Allen, archt., Garden City, N. Y., making plans group 40 dwellings or more and tract development, near Spring Brook Golf Course. $140,000.

N. J., Newark—Harrison Impvt. Co., 355 Mt. Prospect Ave., Newark, and New Brunswick, plans 5 story apartment, 355 Mt. Prospect Ave. $150,000 or more. Site acquired.

N. J., Wequahic—First Colonial Rd. Corp., c/o F. Menkes, Elizabeth and Custer Aves., Newark, plans 5 story apartment, Elizabeth and Custer Aves. $300,000.

★**N. Y., Ardsley-on-Hudson**—Syndicate, c/o W. B. Walker, 165 Bway., New York, and Rolland Rd., Ardsley-on-Hudson, plans by Shreve Lamb & Harmon, 11 East 44th St., constructing apartment house. $750,000.

N. Y., Brooklyn—Corporation, c/o N. Kapeloff, 449 Kings Highway, plans by I. Kallich, 375 Fulton St., group 2 story brick dwellings, East 28th St. near Quentin Rd. $140,000.

N. Y., Brooklyn—Hospital of Holy Family, 283 Hicks St., plans by Crow, Lewis & Wick, 200 5th Ave., New York, 6 story hospital, $200,000 or more. **Maturity later.**

N. Y., Brooklyn—S. Geller, 1555 East 29th St., plans by Kavy & Kavovitt, 16 Court St., 6 story, apartment, 21st St. and Avenue N. $180,000.

★**N. Y., Brooklyn**—Robert Goetz, c/o Seelig & Finkelstein, archts., 153 Pierrepont St., plans 9 story apartment, Bay Ridge. $1,000,000.

N. Y., Brooklyn—R. Goetz, c/o Seelig & Finkelstein, archts., 153 Pierrepont St., plans 9 story apartment, near Flatbush Ave. To exceed $150,000.

N. Y., Brooklyn—Mambern Realty Corp., 2885 Coney Island Ave., plans by Seelig & Finkelstein, 153 Pierrepont Ave., 6 story, apartment, Dover St. and Oriental Blvd. Est. about $140,000.

N. Y., Brooklyn—Seventy-Five Martense Street Corp., 2715 Avenue K, plans by M. N. Weinstein, 83 Court St., constructing 6 story apartment, 75 Martense St. $150,000.

N. Y., Brooklyn—H. Waxmann, 2031 72nd St., plans by I. Kallich, 375 Fulton St., group 2 story, frame dwellings, Hampton and Ocean Aves.; and frame dwellings at Oriental Blvd. and Dover St. $140,000.

N. Y., Brooklyn—Williamsburg Savings Bank, 1 Hanson Pl., plans by G. I. Prowler, 367 Fulton St., altering heating, plumbing in 4 story apartment, 109 Greenpoint Ave. Est. about $39,000 with fixtures.

N. Y., Douglaston—Desirable Homes, Inc., Cambria Ave. and Marathon Parkway, Little Neck, plans by A. Fahr, 90-23 161st St., Jamaica, group 2 story frame dwellings, Cambria Ave. near 248th St. $140,000.

N. Y., Flushing—Pincus and L. Glickman, 401 Bway., New York, plans by H. I. Feldman, 15 West 44th St., New York, constructing two 6 story apartments, Parson Blvd. and 35th Ave. $300,000.

N. Y., Glendale—Sylvania Homes, Inc., Paramount Bldg., New York, plans by S. M. Palm, 159-15 Northern Blvd., Flushing, group 1 story, brick dwellings, vicinity of 74th St. and Calumus Ave. $140,000.

N. Y., Jamaica—Display Homes, Inc., 391 Fulton St., Brooklyn, plans by M. Rothstein, 186 Joralemon St., Brooklyn, group 2 story frame dwellings, 80th Rd. and Surrey Pl. $140,000.

N. Y., Laurelton—English Cottage Homes, Inc., 49th St., Woodside, plans by A. Fahr, 90-23 161st St., Jamaica, group 1 story frame dwellings, 231st Pl. and 131st Rd. $140,000.

N. Y., New York—E. Bornholft, 33-31 89th St., Long Island City, plans by L. E. Ordwein, c/o owner, altering plumbing, heating in 5 story apartment, 1258 3rd Ave. $37,000 with fixtures.

N. Y., New York—Corporation, c/o Cross & Brown, 270 Madison Ave., plans apartment, 254th St. and Independence Ave. $150,000 or more. Site acquired. Architect not appointed.

N. Y., New York—Dale Housing Corp., 119 West 25th St., plans by S. M. Palm, 159-15 Northern Blvd., Flushing, group 2 story frame dwellings, Neill and Tenbroeck Aves. $14[illegible],000.

N. Y., New York—S. Derfner, 161 East Gun Hill Rd., plans 6 story apartment, Gates Pl. $150,000 or more. Architect not appointed.

N. Y., New York—S. Derfner, 161 East Gun Hill Rd., plans 6 story apartment, DeKalb Ave. near Gun Hill Rd. $150,000 or more. Architect not appointed.

N. Y., New York—Excelsior Savings Bank, plans by J. M. Berlinger, 17 East 49th St., altering plumbing and heating and constructing 1 story addition to apartment, 590 West End Ave. $200,000.

★**N. Y., New York**—Lebanon Hospital, Westchester and Cauldwell Aves., plans by C. B. Meyers, 31 Union Sq., constructing hospital, Westchester and Cauldwell Aves. $2,500,000.

★**N. Y., New York**—Rockefeller Center, Inc., 30 Rockefeller Plaza, plans by Reinhard & Hofmeister, Corbett & MacMurray, W. K. Harrison and J. A. Fouilhoux, 30 Rockefeller Plaza, constructing 32 story office building, 12 and 14 and 26-42 West 49th St. and 9-17 and 23 and 25 West 48th Sts. $3,500,000.

N. Y., New York—G. Provot, archt., 22 East 17th St., soon takes bids general contract altering heating, plumbing in 3 and 5 story store and apartment, 344 West 17th St., for New York Savings Bank, 81 8th Ave. Est. about $39,000. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

N. Y., New York—Timken Realty Corp., 597 Madison Ave., plans by V. Bark, Jr., 1351 Bway., altering plumbing, heating in 17 story office building, 509 7th Ave. $37,000 with equipment.

N. Y., Queens Village — Interpark Homes, 93-31 85th Rd., Woodhaven, plans by J. E. Cahill, 89-64 163rd St., Jamaica, constructing group 2 story frame dwellings, 91st Ave. near 219th St. $140,000.

N. Y., Rochester—Union Trust Co., 19 West Main St., plans almost complete by F. H. Day, 1017 Commerce Bldg., altering and constructing store and office building addition, Main St. $100,000-$150,000. Will be awarded soon without taking competitive bids.

N. Y., Tonawanda—**First Church of Christ** Broad St. bids in July brick, stone, steel church and parsonage, plain found., Grove St. $105,000. Green & James, 1 Niagara St., Buffalo, archts. Noted Apr. 24. C.D.—Apr. 30, E.N.-R.

N. Y., Yonkers—L. Silver, c/o J. Howard Katz, 535 5th Ave., New York, plans 122x200 ft. theater and store, Yonkers Ave. and Bronx River Parkway. $140,000. Site acquired.

★**N. C., New Bern**—Lord Craven Hotel Corp., R. Fuson, pres., New Bern, plans 9 story, 155 room hotel at Union Point, junction of Neuse and Trent Rivers. $500,000.

O., Cleveland—Cleveland Hockey, Inc., A. Sutphin, pres., 1720 East 22nd St., plans by Warner & Mitchell, Bulkley Bldg., 1 story, 260x265 ft., brick, steel, concrete sports building. $250,000.

Alta., Calgary—Salvation Army Authorities making plans addition to Grace Maternity Hospital, West Calgary. $200,000.

B. C., Vancouver — Chown United Church, 10th and Ontario Sts., plans constructing church. Est. about $140,000. Architect not appointed. **Maturity indefinite.**

BIDS ASKED

Calif., West Los Angeles—Twentieth Century-Fox Film Corp., 10260 Orton Ave., takes bids about May 25 (selected list of bidders), 3 story, 37x212 ft., rein.-con., steel film cutting and storage building, incl. steel, gas heating, automatic water heater, projecting booths, sheet metal work, $140,000; taking bids (selected list of bidders), 135x212 ft. and 135x240 ft. steel frame sound stages. Furnishing steel frames for 2 sound stage buildings, to Bethlehem Steel Corp., East Slauson Ave., Los Angeles. Noted May 15. C. D.—May 21. E. N.-R.

Mo., University City—All Saints Roman Catholic Church, G. M. Ryan, pastor, 5403 Clemens Ave., bids about May 25, 1 story, basement, 70x130 ft., rein.-con., stone church, Westgate and Clemens Ave. H. P. Hess, 1001 Ambassador Bldg., St. Louis, archt. Noted Apr. 16. C.D.—Apr. 23. E.N.-R.

N. J., Glen Rock—See "Contracts Awarded."

N. Y., Bayside—See "Contracts Awarded."

N. Y., Flushing—See "Contracts Awarded."

N. Y., Long Island City — See "Contracts Awarded."

N. Y., New York—See "Contracts Awarded."

N. Y., Rego Park—See "Contracts Awarded."

Ont., Toronto—W. B. Isbister, 5 Burlington St., taking sub-bids 32 suite, brick apartment and 23 car garage, plain founds., on Bathurst St. $150,000.

†*Federal Government*

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Commercial Buildings (Continued)

CONTRACTS AWARDED

★ **Calif., Palm Springs**—Patterson Estate, c/o National Cash Register Co., South Main and K Sts., Dayton, O., theatre, garage, stores, etc., to W. O. Warner, 8167 West 3rd St., Los Angeles. Total est. $1,500,000. The first unit to be constructed will be a 2 story garage or rein.-con. and chauffeurs' quarters. Schenck & Williams, 3rd Natl. Bldg., Dayton, O., and Palm Springs Plaza, Palm Springs, archts.

Calif., Trona—American Potash & Chemical Corp., 609 South Grand Ave., Los Angeles, constructing 61 houses and garages and 2 dormitories, to E. S. McKittrick Co., 5905 Pacific Blvd., Huntington Park. To exceed $200,000. Noted Apr. 29, C. D.—May 7, E. N.-R.

Ind., Indianapolis—Rubush & Hunter, archts., 1020 Architects & Builders Bldg., general contract 8 story, basement, 50x180 ft. department store addition, Meridian and Washington Sts., for H. P. Wasson Co., 16 West Washington St., to W. P. Jungclaus Co., 825 Massachusetts Ave., $215,000. Bids May 16. Noted Apr. 24, C. D.—Apr. 30, E. N.-R.

N. H., Concord—St. Paul's School, 3 story, basement, 69x159 ft., 52x72 ft., 30x48 ft., brick, steel, stone school, to J. W. Bishop Co., 109 Foster St., Worcester, Mass. Est. $300,000. Separate contracts awarded. Bids Mar. 24, awarded recently. Noted Mar. 10, C. D.—Mar. 12, E. N.-R.

N. J., Glen Rock—Model Home Builders, Inc., E. Blomkuest, pres., Ackerman Ave., constructing group of dwellings on 70 lots, Ackerman Ave., day labor and separate contracts. $140,000. P. A. Tiagwad, Ridgewood, archt.

N. Y., Bayside—Thebes Realty Corp., 38-18 Bell Ave., constructing group frame dwellings, 204th St. and Crocheron Ave., day labor and separate contracts. $140,000. Owner will purchase material. J. Unger, 39-01 Main St., Flushing, archt. Noted Apr. 22, C.D.—Apr. 30, E.N.-R.

N. Y., Brooklyn—Corporation, c/o J. Dorment, 66 Court St., constructing group 2 story brick dwellings, 1827 Gerritsen Ave., separate contracts now being awarded. $140,000. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

N. Y., Brooklyn—Parkside Holding Corp., 44 Court St., constructing 6 story apartment, 14th Ave. and 56th St., separate contracts now being awarded. $180,000. M. N. Weinstein, 93 Court St., Brooklyn, archt. Noted Apr. 22, C.D.—Apr. 30, E.N.-R.

N. Y., Brooklyn—Aberg Realty Corp., T. Steinberg, secy., 16 Court St., 6 story apartment, 1346 54th St., separate contracts, $140,000. Kavy & Kavovitt, 16 Court St., archts.

N. Y., Brooklyn—Monroel Realty Corp., 535 5th Ave., New York, constructing 6 story apartment, 118 Ocean Parkway, by separate contracts now being awarded. $140,000. H. I. Feldman, 15 West 44th St., New York, archt.

N. Y., Buffalo—William Hengerer Co., 465 Main St., Buffalo, and Associated Dry Goods Corp., 4 West 35th St., New York, general contract altering and constructing department store addition, 465 Main St., to J. W. Cowper Co., 775 Main St. F. J. and W. A. Kidd, 524 Franklin St., archt. Noted Apr. 15, C. D.—Apr. 23, E. N.-R

N. Y., Flushing—Morris J. Roth, Elder Ave., Main, Colden and Cherry Sts., constructing group 75 dwellings, Elder Ave., Main, Colden and Cherry Sts., separate contracts and day labor. $140,000 or more. Private plans. Noted Apr. 16, C.D.—Apr. 23, E.N.-R.

N. Y., Great Neck—Sorens K. Petersen, Old Mill Rd., constructing group 35 brick dwellings, Old Mill Rd., separate contracts awarded. $140,000 or more. Private plans. Noted Apr. 16, C.D.—Apr. 23, E.N.-R.

N. Y., Johnson City—St. James Roman Catholic Church, 143 Main St., brick, steel parochial school, plain found., to J. T. Kane, 25 Parsons St., Binghamton, to exceed $100,000. Noted Apr. 8, C.D.—Apr. 16, E.N.-R.

N. Y., Jamaica — Caye Constr. Co., general contractors, 356 Fulton St., Brooklyn, 400 tons structural steel for department store annex, for Gertz & Co., 162-10 Jamaica Ave., to Harrison Structural Steel Co., 419 4th Ave., New York. Noted Apr. 27, C. D.—Apr. 30, E. N.-R., under "Contracts Awarded."

N. Y., Long Island City—Whitney Crescent Corp., 24-16 Bridge Plaza, 6 story apartment, 30th Rd. and Crescent St., separate contracts. $350,000. B. Braunstein, 163-18 Jamaica Ave., archt. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

★ **N. Y., New York**—Rockefeller Center, Inc., 30 Rockefeller Plaza, constructing 32 story, 90x115x182 ft. office building, 12 and 14 and 26-42 West 49th St., and 9-17 and 23 and 25 West 48th St., to Todd & Brown, 30 Rockefeller Plaza. Est. $3,500,000. Noted May 20, C. D.

N. Y., New York—Starlight Properties, Inc., 328 East 53rd St., altering heating, plumbing in 4 story apartment, 233 East 54th St., separate contracts. Est. about $40,000. C. N. and S. Whinston, 2 Columbus Circle, archts. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

N. Y., Niagara Falls—Darojo Realty Co., 270 Bway., New York, reconstructing 4 story, basement office building, Main St., recently destroyed by fire, to W. S. Johnson Building Co., 2532 Hyde Park Blvd. Noted Feb. 25, C. D.—Feb. 27, E.N.-R.

N. Y., Niagara Falls—St. John de La Salle Church and School, 8469 Buffalo Ave., constructing school and church, Buffalo Ave., separate contracts awarded: carpentry work, to C. Hoff, 1622 16th St., Niagara Falls***masonry work, to Sinclair & Mackay, 2236 Niagara Ave., Niagara Falls***and roofing, to F. Swan, 1187 Haeberle Ave. Noted Apr. 29, C.D.—May 7, E.N.-R.

N. Y., Rego Park—Budget Homes, Inc., 62nd Ave. and 82nd Pl., constructing group frame dwellings, 82nd St. and 62nd Ave., day labor and separate contracts. $140,000. J. Unger, 39-01 Main St., Flushing, archt. Noted Dec. 2, C.D.—Dec. 5, E.N.-R.

N. Y., Syracuse — St. Anthony of Padua Roman Catholic Church, 1605 Midland St., constructing convent, to W. C. Kelly, 413 Glenwood Ave.; parochial school, to Dawson Bros., Union Bldg. Noted May 13, C.D.—Apr. 16, E.N.-R.

N. Y., Valley Stream—Schlossman Bros., Valley Stream Park, constructing group dwellings near Merrick Rd. and Sunrise Hy., separate contracts now being awarded. $140,000. Owner is purchasing material. Private plans. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

Pa., Erie—St. Mary's Parish, 2 story, 90x145 ft. recreational center and connecting passage to St. Mary's School adjoining 10th St., to Upton & Lang, Erie. Est. exceeds $140,000. Awarded May 13. G. W. Stickle, 228 Commerce Bldg., archt.

S. C., Columbia—Hotel Columbia, L. S. Barringer, 33 room addition, each with private bath, to present building, to J. C. Heslep, Carolina Bank Bldg., $60,000. Originally plant addition would cost $150,000 but plans revised to cut cost to $60,000. Noted Feb. 13, C. D.—Feb. 20, E. N.-R.

INDUSTRIAL BUILDINGS

PROPOSED WORK

Conn., Hartford—FACTORY—United Aircraft Corp., plans completed by Albert Kahn, Inc., New Center Bldg., Detroit, Mich., 1 story, brick, steel, rein.-con. aircraft factory and office building for addition to aircraft plant, plain found.

Conn., New Haven—PLANT—Hull Brewing Co., 820 Congress Ave., plans by H. H. Davis, 20 Whitney Ave., 2 story, basement, 61x100 ft., brick, steel beer bottling and canning plant, Bond St. $55,000. A. M. Thomas, 20 Whitney Ave., engr.

Ind., Marion — SOYBEAN PLANT — Hoosier Soybean Mills, Inc., J. H. Caldwell, pres., soon takes bids remodeling newly purchased structure into soybean mill, 400,000-500,000 bu. annual capacity, 33rd and Nebraska Sts. $75,000. Private plans.

Mass., East Brookfield—FACTORY—Anderson & Nichols Associates & Co., engrs., 330 West 42nd St., New York, will award separate contracts for remodeling 7 factory buildings, incl. carpentry, brick work, roofing, sash, heating, plumbing, electrical work, sprinklers and new boilers, for owner, c/o engineers. Est. about $37,000. Private plans.

Mich., Dearborn—STORAGE, etc.—American Blower Co., plans prepared by Albert Kahn, Inc., Marquette Bldg., Detroit, 2 story, brick, steel, rein.-con. storage, factory type building, Tireman Ave. $50,000.

Mich., Marysville—STORAGE—Chrysler Corp., Oakland and Massachusetts Aves., Highland Park, plans 1 story, 350x800 ft., brick, rein.-con., steel storage plant for automobile industry, plain found. $400,000. Smith, Hinchman & Grylls, Marquette Bldg., Detroit, engrs.

New York—STORAGE, etc.—F. W. Woolworth Co., Woolworth Bldg., New York, and 75 State St., Albany, soon takes bids constructing storage and store, West Domenick St., Rome, about $100,000; storage and store, State St., Carthage, $100,000; and storage and store, Main St., Johnson City, about $100,000. A. F. Winters, Woolworth Bldg., New York, archt.

N. Y., Brooklyn—PLANT—National Lead Co., 35 Marshall St., plans by E. Kleinert, 8029 Shore Rd., 2 story, 15x62 ft. plant addition, 143 John St. Est. about $37,000 with equipment.

N. Y., Long Island City—FACTORY—P. and D. Realty Corp., 30-02 22nd St., plans by W. Shary, 22 East 17th St., New York, constructing factory, 19th Ave. and 38th St. $55,000.

N. Y., Long Island City—STORAGE—United Casket Co., 25th Ave. and 47th St., plans by V. Schiller, 39-64 41st St., Astoria, constructing storage, 25th Ave. and 47th St. $37,000 with equipment.

N. Y., New York—FACTORY—Garment Center Capitol, Inc., 512 7th Ave., plans by Sugarman & Berger, 17 East 49th St., altering 23

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Industrial Buildings (Continued)

story factory, 494 7th Ave. $37,000 with equipment.

N. Y., New York—MANUFACTURING—Fifty-Two West 39th Street Realty Corp., 42 West 39th St., plans by E. J. Kahn, 2 Park Ave., altering 18 story, manufacturing building, 42 West 39th St. $37,000 with equipment.

N. Y., North Tonawanda—PLANT—National Grinding Wheel Co., Inc., Walck Rd., soon lets general contract, heating, plumbing, electrical work for plant addition, incl. office building and storage room, etc., Walck Rd. W. O. Johnstone, Sweeney Bldg., archt.

N. Y., Syracuse—PLANT—Continental Can Co., Water St., Syracuse, and 110 East 42nd St., New York, plans brick, concrete plant addition, 1016 East Water St. $40,000. Private plans.

N. C., Hickory—MILL—T. M. Whitener plans new hosiery mill. $50,000.

Pa., Corry—PLANT—Aero Supply Corp., L. E. Graham, vice-pres., Corry, plans 2 story, 40x80 ft., brick, steel addition to aviation parts manufacturing plant, $40,000. **Maturity soon.** Architect not appointed.

Pa., Etna—PLANT—Metzer Bolt & Nut Co., Etna, plans rebuilding plant recently destroyed by fire. $38,000 or more. Architect not appointed.

Va., Norfolk — DAIRY — Birtcherd's Dairy, Monticello Ave. from 16th to 17th Sts., plans by Rudolphe, Cooke & Van Leeuwen, Norfolk, and takes bids within a month 2 story, rein.-con. building. $100,000 with machinery and equipment.

Va., Waverly—FACTORY—Barnhart Tucker Peanut Co. soon takes bids rebuilding factory, damaged by fire. To exceed $30,000.

Wash., Aberdeen—PLANT—Taylor Chemical Co. plans rebuilding or equipping plant. Est. about $37,000 with equipment. Architect not appointed. **Maturity indefinite.**

Wash., Seattle—PLANT—Casein Mfg. Co. of America, 701 Myrtle St., plans replacing plant destroyed by fire. Loss $150,000. Architect not appointed.

Wis., Milwaukee—PLANT—Continental Can Co., 100 East 42nd St., New York, plans can manufacturing plant. Site being selected. To exceed $50,000. **Maturity indefinite.**

B. C., Vernon—STORAGE PLANT, etc.—Vernon Fruit Union plans 100x175 ft. packing house, 75x175 ft. cold storage plant, Woods Lake. $70,000.

★ **Ont., Hamilton**—PLANT—Steel Co. of Canada Ltd., Wilcox St., plans 4 or 5 new buildings and plant alterations. $1,000,000. Private plans.

Ont., Toronto — POWER HOUSE — Canadian Kodak Co. Ltd., Mt. Dennis, soon takes bids 3 story, fireproof addition to power house, Eglinton St. To exceed $50,000. Private plans.

Ont., Orillia—BAKERY—Fair's Bread Ltd., C. Vernon Bennett, plans constructing modern bakery. $40,000.

Ont., Waterloo — FACTORY — Superior Box Co., 63 William St. E., Ira Good, mgr., plans 125x125 ft., brick addition to factory.

BIDS ASKED

Ala., Birmingham—PLANT—See "Contracts Awarded."

Calif., Burbank — DISTILLERY — Three G Distillery, 3112 West San Fernando Rd., Burbank, D. Greenberg, pres., 5335 Melrose Ave., Los Angeles, taking bids general contract 45x50 ft. tower building to house distilling equipment, grain bins, roller mills, cookers, etc., tower will be 75 ft. high, steel frame construction, concrete founds., incl. 1 story, masonry boiler house building, fermenting room and cistern room buildings, 3112 San Fernando Rd. $250,000. A. R. Sedgley, 910 North Serrano Ave., Los Angeles, archt. Noted Apr. 16, C. D. —Apr. 23, E. N.-R.

Calif., Culver City — DISTILLERY — Pacific Distillers, 8512 Hays St., taking segregated bids 60x110 ft. and 60x95 ft., 1 story, distillery buildings, incl. rectifying building and denaturing building, 8512 Hays St. To exceed $37,500. A. R. Sedgley, 910 North Serrano Ave., Los Angeles, archt.

Calif., Kingsburg—WINERY—H. R. Lake, archt., Pacific Southwest Bldg., Fresno, bids about May 26, rein.-con. winery addition for Muscat-Co-operative Winery Assn. To exceed $75,000. Noted May 4, C. D.—May 7, E. N.-R.

Calif., Sacramento—WAREHOUSE—F. E. Barton, archt., Crocker Bldg., San Francisco, taking bids 1 story, 80x242 ft., steel, concrete warehouse, for Bekins Van & Storage Co., Otis St., San Francisco.

Ga., Tifton—SUB-STATION—See "Contracts Awarded."

Ind., Indianapolis—FACTORY—D. A. Bohlen & Son, archts., 101 Majestic Bldg., taking bids 2 story, basement, 80x80 ft., brick, steel glass jar manufacturing plant addition, South Keystone Ave., for Fairmount Glass Wks., J. H. Rau, Jr., mgr., Belt Ry. and South Keystone Ave. $80,000.

Mo., Maplewood (St. Loius P. O.)—FACTORY—Alco Valve Co., Inc., J. L. Shrode, genl. mgr., 2628 Big Bend Blvd., bids about May 27, constructing 1 and 2 story, 41x73 ft. factory addition, 2628 Big Bend Blvd. C. R. Kohlmeyer, 720 Pacific Ave., Webster Groves, archt. Noted May 21, C. D.—May 28, E. N.-R.

Mass., Cambridge—MARKET, etc.—Boston Regional Produce Market, Inc., Concord Ave., taking bids superstructure 1 story, basement, 30x100 ft., concrete block produce market and warehouse, concrete found., Concord Ave. Monks & Johnson, 99 Chauncy St., Boston, engrs. Noted May 14, C. D.—May 21, E. N.-R.

Mass., Westfield—GARAGE, etc.—S. J. Alexik, Free St., taking bids 1 story, 65x85 ft., brick, steel garage and repair shop, concrete found., Free St. To exceed $37,000 with equipment. R. M. Sizer, 12 Elm St., archt.

Mo., Maplewood (St. Louis P. O.)—FACTORY—Alco Valve Co., Inc., J. L. Shrode, genl. mgr., 2628 Big Bend Blvd., bids about May 27, constructing factory addition, incl. heating, electrical work, hydraulic lift, 2628 Big Bend Blvd. Private plans.

N. Y., New York—STORAGE—See "Contracts Awarded."

N. Y., Sherill—WAREHOUSE—See "Contracts Awarded."

CONTRACTS AWARDED

★ **Ala., Birmingham**—PLANT—Universal Atlas Portland Cement Co., Brown-Marx Bldg., (subsidiary U. S. Steel Co.), improvements to cement plant (Leeds Mill), day labor and separate contracts. Est. $1,500,000.

Ark., Crossett—MILL—Rust Eng. Co., general contractors, Clark Bldg., Pittsburgh, Pa., brick and masonry for pulp and paper mill, for Crossett Lumber Co., Crossett, to Carter Lyon, Memphis, Tenn. Contractor will erect steel by day labor. Noted Mar. 10, C.D.—Mar. 12, E.N.-R., under "Contracts Awarded."

Calif., San Leandro—FACTORY—F. H. Riemers, archt., 233 Post St., San Francisco, 1 story, 72x262 ft., rein.-con. factory, to F. K. Dupuy, 110 Sutter St., San Francisco. $45,000. Noted May 15, C. D.—Apr. 30, E. N.-R.

Calif., San Pedro—WAREHOUSE—Outer Harbor Dock & Wharf Co., 50x80 ft., concrete warehouse addition, concrete pile found., at Dock 51-54, Outer Harbor, to R. E. McKee, 108 West 6th St., Los Angeles, about $90,000.

Conn., Bridgeport — BOILER PLANT UNIT — Mott Constr. Co., general contractors, 440 Elm St., New Haven, pipe covering for boiler plant unit, at Steel Point Power Station, for United Illuminating Co., 84 Temple St., New Haven, to Johns-Manville, Inc., 60 Washington Manor, West Haven*** reinforcing steel, to Truscon Steel Co., 42 Church St., New Haven***structural steel, to Leake & Nelson Co., Inc., 203 Ash St., Bridgeport. Noted Apr. 13, C. D.—Apr. 16, E. N.-R., under "Contracts Awarded."

Conn., Bridgeport—FACTORY—Edwin Moss & Son, Inc., general contractors, 729 Union Ave., electrical work for 1 story, 90x200 ft., brick, steel factory, to Eastern Electric Constr. Co., 1208 Stratford Ave., for Hemco Division of Bryant Electric Co., 1421 State St., H. E. Seim, genl. mgr. Noted Apr. 7, C. D.—Apr. 9, E. N.-R., under "Contracts Awarded."

Conn., Hartford—FACTORY—Silex Co., 88 Pliney St., Hartford, general contract 1 story, 45x142 ft., brick factory addition, 15x40 ft. platform, Pliney St., to Allyn Wadhams, 15 Lewis St.; excavating, to E. B. McGurk, Inc., 1300 Albany Ave. Est. $37,000. Private plans.

Ga., Tifton — SUB-STATION, etc. — Georgia Power Co., 75 Marietta St. N.W., Atlanta, F. A. Jordan, purch. agt., 1 story sub-station, incl. electrical equipment and installation of same, separate contracts. Est. about $100,000. Private plans. Owners will purchase structural steel, wire, brick and all necessary equipment and are building transmission line from Americus to here.

★ **Ind., Indiana Harbor**—COLD REDUCTION MILL—Youngstown Sheet & Tube Co., Youngstown, O., two 42 in. cold reduction mill and skin pass mill (tin plate mill improvements), to United Eng. & Fdry. Co., 1st Natl. Bldg., Pittsburgh, Pa. Est. $1,300,000.

Mo., St. Louis—FACTORY—Wagner Electric Corp., 6400 Plymouth Ave., constructing 2 story, 120x504 ft. electric manufacturing plant addition, near 6401 Page St., to G. Hercules Constr. Co., 7807 Forsythe St., Clayton. Condon & Post, Chicago, Ill., archts.

Mo., St. Louis—GARAGE—Florissant Real Estate & Investment Co., c/o H. W. Kiel, Federal Trust for St. Louis, Public Service Co., 3869 Park Ave., rein.-con. floors, 5 in. thick to be laid in Bays 1 and 2 of Hodiamont Bus Garage, in connection with conversion of former street car shed into a motor bus garage, Maple and Hodiamont Aves., to Woermann Constr. Co., 3800 West Pine Blvd. Bids May 5.

N. Y., Albany—WAREHOUSE—J. P. Sewell, general contractor, 372 Hudson Ave., 100 tons reinforcing steel for storage building, North Albany plant, for A.P.W. Paper Co., 1273 Bway., to Strope Steel Co., Terminal St. Noted May 7, E. N.-R., under "Contracts Awarded."

N. Y., Brooklyn—STORAGE, etc.—Thirty-Five Steuben Street Corp., 351 Park Ave., constructing 2 story, 100x110 ft. brick, storage and factory, Park Ave. and Steuben St., separate contracts awarded. $110,000. M. Klein, 65 Court St., archt. Noted Apr. 20, C.D.—Apr. 23, E.N.-R.

N. Y., New York—STORAGE—Fidelity Brewery, Inc., 501 1st Ave., 3 story storage, 337 East 29th St., to Rheinstein Constr. Co., 21 East 40th St., New York. Est. $38,000 with equipment. J. D. Weiss, 119 West 57th St., archt. Noted Apr. 22, C.D.—Apr. 30, E. N.-R.

N. Y., Niagara Falls—CARBON PLANT—Wright & Kremers, Inc., general contractors, Main St., structural steel for plant addition, Highland Ave., for Moore Research & Service Co., 1st St., to Buffalo Structural Steel Corp., 166 Dart St., Buffalo***reinforcing steel, to J. T. Ryerson & Son, 40 Stanley St., Buffalo***elevators, to Warsaw Elevator Co., 64 Delaware Ave., Buffalo. Noted Apr. 3, C.D.—Apr. 9, E. N.-R., under "Contracts Awarded."

N. Y., Niagara Falls—PLANT—W. S. Johnson Building Co., general contractors, 2532 Hyde Park Blvd., steel piling and reinforcing steel for plant, Buffalo Ave., for Niagara Alkali Co., 4205 Buffalo Ave., to Bethlehem Steel Co., Bethlehem, Pa. Total est. $50,000. Noted Apr. 9, C. D.—Apr. 16, E. N.-R., under "Contracts Awarded."

N. Y., Sherill—WAREHOUSE—Oneida Community, Ltd., Sherill, constructing 2 story 51x240 ft., brick warehouse, Seneca St., by separate contracts. To exceed $37,000. E. D. Pitt, Kenwood, archt.

N. Y., Troy—GARAGE—Hudson Valley Fuel Corp., 126 State St., garage at coke plant, to Stone Bros Building Co., 1814 Highland Ave., Troy. Est. $35,000-$40,000. Noted May 5, C.D.

N. C., Durham—TOBACCO DRYING BUILDING—Liggett-Myers Tobacco Co., Durham, constructing large tobacco drying building, glass block construction, to Wm. Muirhead Constr. Co., Durham. Private plans.

O., Hamilton — POWER PLANT — Beckett Paper Co., boiler for power plant, to Babcock & Wilcox Co., Carew Tower, Cincinnati*** power pipe, to Peck Hannaford & Briggs, Court and Sycamore Sts., Cincinnati***pipe covering, to Kramig Co., 222 East 14th St., Cincinnati ***concrete chimney and silo, to Rust Eng. Co. ***smoke correction, to United Welding Co., 810 Elm St., Cincinnati***building, to F. H. Vaughn Building Co., 708 First Natl. Bank Bldg. Est. $250,000. Bids Apr. 15. Noted Apr. 9, C. D. —Apr. 16, E. N.-R.

Pa., Glen Rock—WAREHOUSE—Foust Distilling Co., M. Maynard, pres., general contract 5 story, 140x200 ft., concrete, frame and block warehouse, to M. L. McMillan, c/o owner*** concrete blocks, to Standard Concrete Products Co., North Sherman St. Ext., York***5,000 bags cement, to Neuhouse Co., Glen Rock*** lumber, to Glen Mfg. Co., Glen Rock. Est. $40,000. Owner taking bids for complete air-conditioning system for plant.

R. I., Providence—SUPER-SERVICE STATION—Petroleum Service Co., Inc., 271 Fox Point Blvd., 1 story, 26x100 ft. and 30x40 ft., brick, steel, timber, concrete found., to Kelman & Kelman, 628 Broad St. Barker & Turoff, 739 Grosvenor Bldg., archts

S. D., Lead—COMPRESSOR PLANT—Homestake Mining Co., G. A. Bjerge, asst. supt., 50x105 ft. compressor plant, incl. two 5,000 cu ft. compressor, to Nordberg Co., 3073 South Chase St., Milwaukee, Wis. Est. $150,000.

Wis., Milwaukee—PLANT—Swift & Co., Chicago, Ill., constructing 1 story, basement, 100x150 ft. addition to fertilizer manufacturing building, South Muskegon St., to Hunzinger Constr. Co., 1827 North 27th St. H. C. Watts, Union Stock Yard, Chicago, engr.

Ont., Chatham — FACTORY — W. H. Yates Constr. Co., general contractors, 17 Main St., Hamilton, plumbing for 2 story, 80x80 ft., rein.-con. steel addition to plant, for Libbey McNeill & Libbey, of Canada Ltd., Richmond St., to J. Kearn, 343 Randolph St.***structural steel, to Sarnia Bridge Co., 251 Campbell Ave., Sarnia ***reinforcing steel, to Dominion Bridge Co. Ltd., 1139 Shaw St., Toronto***steel sash, to Canadian Metal Window & Steel Products Ltd., 160 River St., Toronto***millwork, to P. S. Piggett Co. Ltd., 335 King St. W.***painting, to W. Marshall & Son, 141 Raleigh Ave.

Ont., Chatham—PLANT—W. H. Yates Constr. Co. Ltd., general contractors, 17 Main St. E., Hamilton, painting 2 story, basement, 80x80 ft., rein.-con., steel addition to food manufacturing plant, plain found., for Libby, McNeill & Libby, Canada Ltd., 350 Richmond St. W., to W. Marshall & Son, 141 Raleigh Ave. Noted Apr. 8, C. D.—Apr. 16, E. N.-R.

Ont., Toronto—DISTILLERY—Angline Norcross Ontario Ltd., general contractors, 57 Bloor St., plumbing and heating for distillery, 18th St., for W. & A. Gilkey Ltd., 18th St., to Bennett & Wright Co. Ltd., 72 Queen St. Noted May 5, C. D.—May 7, E. N.-R.

Ont., Toronto—FACTORY—United Drug Co. Ltd., 68 Broadview Ave., general contract 3 story, brick, steel addition to present factory, to W. Davidson & Co. Ltd., 188 Duke St.*** structural steel, to Frankel Bros., Eastern Ave.*** steel sash, to Canadian Metal Windows & Steel Products Ltd., 160 River St.***plumbing and heating, to Purdy Mansell Ltd., 63 Albert St ***sprinklers, to W. J. McGuire, 91 Jarvis St ***wiring, to Smith & Long, 2 College St. Est. $60,000. Noted May 1, C. D.—May 7, E. N.-R

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